DOCUMENT RESUME

ED 158 013 CE 017 343

TITLE	Guidelines on Pregnancy and Work. Research Report.
INSTITUTION	American Coll. of Obstetricians and Gynecologists, Chicago, Ill.
SPONS AGENCY	National Inst. for Occupational Safety and Health (DHEW/PHS), Rockville, Md.
PUB DATE	Sep 77
CONTRACT	210-76-0159
NOTE	82p.
AVAILABLE FROM	Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
EDRS PRICE	MF-$0.83 HC-$4.67 Plus Postage.
DESCRIPTORS	*Employment Practices; *Environmental Influences; Federal Legislation; *Guidelines; Gynecology; Health Guides; Health Needs; Health Programs; Job Placement; Occupational Diseases; Perinatal Influences; Physiology; *Pregnancy; Prenatal Influences; *Safety; Special Health Problems; Work Environment; Work Experience; *Working Women
IDENTIFIERS	Occupational Safety and Health Act

ABSTRACT

Presented in seven sections, these guidelines developed largely by physicians are designed to protect the pregnant worker's health. As defined in section I, the guidelines seek to aid the pregnant worker's physician to develop recommendations for job placement, work continuation during pregnancy, and return to work following delivery. In section II health and job-related problems, pregnancy-related disability, and other issues are addressed. It is noted that despite legislation, such as the Occupational Safety and Health Act, problems remain. Peri-conceptional hazards are considered in section III; section IV discusses the physician's assessment of the patient's work and occupational environment. A sample form to aid assessment is included. Section V explores alternative physician recommendations for the worker's job fulfillment. A chart of toxins and effects is presented. Section VI examines physiological changes by trimester, followed by a systems review of normal pregnancy, complications, and environmental factors. The appendixes contain references, suggested readings, and contact addresses for the National Institute for Occupational Safety and Health, the Occupational Safety and Health Administration, state designated agencies, medical schools, and professional associations. Data and examples of women's occupational exposures, a glossary of occupational medicine terms, and an index for the guidelines are also appended. (CSS)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED158013

GUIDELINES ON PREGNANCY AND WORK

The American College of
Obstetricians and Gynecologists
Chicago, Illinois 60601

Contract No. 210-76-0159

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health
5600 Fishers Lane
Rockville, Maryland 20857

September 1977

For sale by the Superintendent of Documents, U.S. Government
Printing Office, Washington, D.C. 20402

CE 017 343

DISCLAIMER

The contents of this report are reproduced herein as received from the contractor except for minor editorial changes.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

This document contains clinical information that is currently accepted and used by recognized experts. It does not, however, represent official policy of the American College of Obstetricians and Gynecologists, and should not be construed as excluding other methods and techniques.

NIOSH Project Officer: Kenneth Bridbord, M.D.
ACOG Project Director: Ervin E. Nichols, M.D.

DHEW (NIOSH) Publication No. 78-118

PREFACE

During the past two decades, three noteworthy trends have emerged:

-- the shift of millions of women to employment outside the home;

-- the expectation of equal employment opportunity;

-- growth of knowledge about environmental health hazards.

Each has generated a host of issues and problems which, in turn, have spawned new laws and regulations intended to resolve them.

Advances in medical knowledge, and belief in each woman's right to understand and participate in the management of her pregnancy, have swept away many of the myths and misunderstandings about childbearing. Simultaneously, technological advances have brought thousands of new processes and products into the work place and the home. To some of these, the integrity of the germ tissue of prospective parents or the health of the pregnant woman or her fetus may be vulnerable.

Several years ago, a small group of occupational physicians and obstetricians became concerned with the implications of these trends for the health of the pregnant worker and recognized the need for better information and communication. Tentative explorations led to the formation of an interdisciplinary ad hoc committee that focused on one particular aspect of the overall problem: providing the attending physician with information about the potential hazards in the work and work environment of the pregnant worker. This effort became a formal project in July 1976 with the award of contract number 210-76-0159 to the American College of Obstetricians and Gynecologists (ACOG) by the National Institute for Occupational Safety and Health (NIOSH).

The primary objective of this project was preparation and publication of these guidelines, designed to help the practicing obstetrician assemble and interpret the information necessary for appropriate clinical recommendations to pregnant workers. They were to be limited, for the most part, to matters of health; the important social, economic, legal, labor-management, and other nonmedical issues were not intended to be resolved here.

The project also was to include for NIOSH a bibliography of English and foreign articles dealing specifically with the influence of the work and home environment on the health of mother and fetus. Significant gaps in present knowledge of this subject were to be identified, with emphasis on areas in which study and research are most urgently needed.

A core panel of occupational physicians and obstetricians was selected

to serve as the steering group. Assisted by the ACOG staff, it was assigned responsibility for the philosophy, format, and content of the guidelines.

Consultants from various scientific fields were also appointed to provide information and guidance with respect to their particular disciplines. In addition, to assure the utility of these guidelines, physicians actively engaged in the practice of obstetrics and occupational medicine were included.

The project encouraged participation of consultants with expertise in other fields to give breadth and social dimensions to the document. They had the job of pointing out effects that clinical recommendations derived through the guidelines might have on nonmedical issues, and to help insure that the guidelines were not written in a way that would permit them to be misinterpreted as an advocacy position on the laws, regulations, and administrative processes through which nonmedical issues are resolved.

Finally, it was decided to publicize the project as widely as possible in the hope of eliciting information, comments, and suggestions that might make the guidelines more complete or more useful.

For their contributions to this project, we wish to thank the core panel members, the consultants, and the many who assisted them: Warren H. Pearse, M.D., Executive Director, Ervin E. Nichols, M.D., Director--Practice Activities, and the officers and staff of the American College of Obstetricians and Gynecologists; John F. Finklea, M.D., Director of the National Institute for Occupational Safety and Health, and Kenneth Bridbord, M.D., who served as Project Officer.

At some time in the near future, a revision of these guidelines will be undertaken under appropriate auspices to make it more complete by adding new information developed through clinical experience and research. To assist in this process, each reader is requested to forward any comments or suggestions to the American College of Obstetricians and Gynecologists, One East Wacker Drive, Chicago, Illinois 60601; or to the National Institute for Occupational Safety and Health, 5600 Fishers Lane, Rockville, Maryland 20852.

Leon J. Warshaw, M.D.
New York, New York
September 1977

CONTENTS

Preface iii
Project Organization vii

I. INTRODUCTION 1
A. Purpose 1
B. Basic Assumptions 1

II. ISSUES 3
A. The Pregnant Worker 3
B. Pregnancy-related Disability 4
C. Related Issues 4

III. PERI-CONCEPTIONAL HAZARDS 6

IV. DATA BASE 7
A. Assessment of Work Exposure 7
B. Questions for Occupational History 9
C. Recordkeeping 10
D. Interprofessional Relations 11

V. THE MEDICAL CARE OF THE PREGNANT WORKER 12
A. Types of Recommendations 12
B. Effective Periods of Recommendations 12
C. Logic Sequence 14
D. Chart of Toxins and Effects 16

VI. SYSTEMS REVIEW OF PREGNANCY AND WORK 17
A. Introduction 17
B. Reproductive System 20
1. Normal Pregnancy 20
2. Reproductive Complications 20
3. Environmental Factors 23
C. Cardiovascular System 28
1. Normal Pregnancy 28
2. Cardiovascular Disease in Pregnancy 29
3. Environmental Factors 30
D. Pulmonary System 31
1. Normal Pregnancy 31
2. Pulmonary Disease in Pregnancy 32
3. Environmental Factors 33

VI. SYSTEMS REVIEW OF PREGNANCY AND WORK (con't.)
E. Musculoskeletal System 33
1. Normal Pregnancy 33
2. Orthopedic Disease in Pregnancy 34
3. Environmental Factors 34
F. Neurologic System 36
1. Normal Pregnancy 36
2. Neurologic Disease in Pregnancy 36
3. Environmental Factors 37

VII. APPENDICES 38
A. References 38
B. Suggested Readings 46
C. Resources and Contacts 48
1. National Institute for Occupational Safety and Health .. 48
2. Occupational Safety and Health Administration 50
3. State Designated Agencies 52
4. Schools of Medicine 62
5. Professional Associations 63
D. Examples of Women's Occupational Exposures 64
E. Glossary of Terms in Occupational Medicine 67
F. Index 69

PROJECT ORGANIZATION

Core Panel

Leon J. Warshaw, M.D. (Chairman)
New York, New York

Dale R. Dunnihoo, M.D., Ph.D.
Ocean Springs, Mississippi

Jacqueline Messite, M.D.
Rego Park, New York

Martin L. Pernoll, M.D.
Portland, Oregon

Forrest E. Rieke, M.D.
Portland, Oregon

Jan Schneider, M.D.
Ann Arbor, Michigan

Louise B. Tyrer, M.D.
Westfield, New Jersey

National Institute for Occupational Safety and Health

John F. Finklea, M.D., Director
Rockville, Maryland

Kenneth Bridbord, M.D., Project Officer
Rockville, Maryland

Staff

Ervin E. Nichols, M.D., Project Director
Washington, D. C.

Albert W. Isenman, Project Administrator
Chicago, Illinois

Ray Brizgys, Research Associate
Chicago, Illinois

Phyllis Lesczynski, Committee Assistant
Calumet City, Illinois

Mary Ficht, Committee Assistant
Chicago, Illinois

Alberta Sholler, Editorial Assistant
Chicago, Illinois

CONSULTANTS

Elizabeth Allen, Ph.D.
Ann Arbor, Michigan

Major Tommie Barber
Arlington, Virginia

Helen Barnes, M.D.
Jackson, Mississippi

Marcus B. Bond, M.D.
Basking Ridge, New Jersey

Don Chaffin, Ph.D.
Ann Arbor, Michigan

Shirley A. Conibear, M.D
Chicago, Illinois

Irene Courtenay, R.N., C.O.H.N.
New York, New York

Jessica G. Davis, M.D.
New York, New York

Mary Davis, R.N., C.O.H.N.
New York, New York

Sergio E. Fabro, M.D.
Washington, D. C.

Edward A. Felder, M.D.
Darien, Connecticut

Joan M. Goodin
Washington, D. C.

Marcia D. Greenberger, J.D.
Washington, D. C.

Edward Hermann, C.E., Ph.D.
Chicago, Illinois

Marjorie G. Horning, Ph.D.
Houston, Texas

Vilma R. Hunt, B.D.S.
State College, Pennsylvania

Sylvia Krekel
Denver, Colorado

Marvin S. Legator, Ph.D.
Galveston, Texas

Rosanna L. Lenker, R.N., C.N.M.
Harrisburg, Pennsylvania

Brig. General Chris Mann
Arlington, Virginia

Stanley C. Marinoff, M.D.
Washington, D. C.

Alan McGowan
New York, New York

Alan A. McLean, M.D.
Westport, Connecticut

Claudia P. Miller
Park Ridge, Illinois

Susan Nelson
McLean, Virginia

Clara Schiffer, M.A.
Washington, D. C.

Ruth G. Shaeffer, Ph.D.
New York, New York

Jeanne M. Stellman, Ph.D.
Brooklyn, New York

Elaine Whitelaw
White Plains, New York

C. Craig Wright, M.D.
Stamford, Connecticut

Carl Zenz, M.D.
West Allis, Wisconsin

I. INTRODUCTION

A. Purpose

These guidelines are meant to protect the health of the pregnant worker and her fetus by helping the practicing physician develop recommendations for her placement in a particular job, for her continuing to work as pregnancy develops, and for her return to work following delivery. They suggest information that may be assembled about the woman's health status, the development of her pregnancy, and the potential hazards of her job or her partner's job. They indicate ways such information may be obtained, and they suggest resources to which the physician may turn for expert interpretation.

The guidelines are a framework for the application of clinical judgment, maintaining the flexibility dictated by the number of constantly changing variables and the lack of precise scientific data.

The guidelines should also help the physician explain recommendations to the pregnant worker in a manner that she is likely to understand, accept, and act on.

Use of the guidelines should aid the attending physician and the occupational physician or nurse, the worker, and her employer and labor union in cooperative efforts to arrange any work modifications that may be indicated.

Finally, the guidelines should be informative about the impact of occupational factors on the woman's general health status, though the main focus here is on the effects in the reproductive cycle.

B. Basic Assumptions

In order that the guidelines be properly and effectively used, a number of basic assumptions must be understood:

1. This document contains the best information available at the time of its preparation. It is anticipated that research and clinical experience will gradually make it obsolete. Physicians will always endeavor to obtain the most current scientific data.

2. The complexity of the problem and the large number of variables make it impossible to present sharply defined criteria that can be applied with precision. The document proposes to offer a structural framework for the application of sound clinical judgment.

3. The attending physician and occupational health staff will observe the ethical and legal precepts governing the confidentiality of medical information. They will discuss with the pregnant worker the meaning of that information as well as the implications of reporting findings and recommendations to the employer or others. They will procure an informed authorization from the woman before making such a report.

4. Physicians will take an active role in seeking to encourage employers, unions and government agencies to develop policies to maximize safety in the work place. In promoting the development of such policies, however, physicians will be bound by constraints of confidentiality between physician and patient.

5. The physician understands that recommendations are not rigid rules, but advice developed in the interests of the pregnant worker and presented to her in a way that will help her understand, accept, and use them. If the woman or those with whom she is involved reject or cannot comply with the physician's recommendations, the physician should not, in turn, reject her.

6. The pregnant worker desires to continue to work as long as she is reasonably able to do so without undue risk to herself, her fetus, or others.

7. The employer values the woman as an employee and is concerned with her well-being. The employer, therefore, will desire that she continue working as long as she can reasonably do so without risk to herself, her fetus, or others, and will arrange any reasonable modifications of the job that will enable her to continue working.

8. The pregnant worker and the employer wish her to receive all of the benefits to which she is entitled under relevant laws, labor-management agreements, and fringe benefit insurance contracts. The employer will not needlessly complicate or hinder the procedures through which she receives those benefits due her.

9. Occupational health personnel act as agents of the employing company with respect to group and statistical information, but are also agents of the pregnant worker with respect to her personal medical records. As her agent, the occupational physician will make available to the pregnant worker and to her attending physician information about her past medical record and all relevant information derived from environmental monitoring and health surveillance programs in the work place.

II. ISSUES

A. The Pregnant Worker

There has been a dramatic surge of women into the labor force in the past decade. In 1976, the female labor force increased by 1.6 million to a total of 39,255,000 (twice the number of new male workers). Two-fifths of the entire work force are female; nearly half the female population is employed or seeking work; given the present birth rate, one million infants will be born in 1977 of women who were employed during pregnancy.[1]

Simultaneously, the awareness of and the concern with occupational health and safety have grown. The Occupational Safety and Health Act (OSH) and other laws have been enacted at federal and state levels to regulate work-related exposures and to establish the rights of workers and the responsibilities of employers for a safe working environment.

The health of the pregnant worker involves several problems:

1. OSH Regulations

These regulations[2] establish standards designed to protect workers, but the existing standards presently cover only a small number of potential hazards. Moreover, in the past, they have generally been based upon data derived from exposure of males or animals, and it is not known how to apply that data to the special circumstances of the pregnant worker and her fetus.

2. Registry of Toxic Effects of Chemical Substances

This registry,[2] published by NIOSH, identifies many industrial compounds that may be harmful and provides information on potential carcinogenesis, mutagenesis, and teratogenesis when it is available. However, there is little or no information about the effects of mixtures of substances or the effect on reproduction. Such combinations may be encountered in the work place, or occur among industrial compounds, medications, and household chemicals.

3. Fetal Effects

Little is known about the factors which cause birth defects, mutagenesis,or fetal carcinogenesis and how they may be related to occupational exposures. Many of these adverse effects are the result of the genetic effects of occupational exposures of men prior to conception. Most fetal damage, however, is not ascribable to any known cause.[3]

4. Employment Opportunity

It is possible that attempts to prevent or limit potential hazardous exposures might inappropriately restrict employment and advancement opportunities for pregnant workers.[4]

B. Pregnancy-related Disability

The assessment of the health and work exposures of an individual woman should lead to recommendations to her about minimizing potential hazards when practical, and help her decide whether she should continue in her job. Often these recommendations are requested by the woman or the employer for the purpose of determining her ability to remain on the job and her eligibility for benefits. The economic results of medical recommendations may sometimes complicate the issue of disability which occurs during a pregnancy.

Some employers, for example, may categorically eliminate pregnant women from their work force, while some women are able to continue working. Other employers may assume that all pregnant women who could work safely would not do so if disability benefits were available, and therefore automatically challenge whether women are able.

It should be noted that the only true disabilities of pregnancy fall into three basic categories:

1. Disability of the pregnancy per se (as occurs in labor and delivery);

2. Disability related to complications (such as in eclampsia, cardiac involvement, or excess fatigue);

3. Disability related to job exposures (such as exposure to excessive levels of toxic substances or abnormal physical stress).

When making recommendations about the woman's actual ability to perform the tasks required by her work, physicians should consider whether her situation fits one of these categories.

Accordingly, women and employers should rely upon the medical evaluation of the individual situation.

C. Related Issues

Physicians' recommendations for or against continued work will inevitably form the basis for a variety of nonmedical decisions. These are related to the right of pregnant women to work, the responsibility of employers to make certain that no ill effects occur because of continued work, and the coverage for pregnancy in benefit programs. These decisions have important social, legal, economic, and moral implications that have not yet been resolved by laws, regulations, or labor-management agreements.

As citizens, physicians should be concerned with policy aspects of these issues. They should not hesitate to participate in the public debate or to advocate positions they find reasonable and just. Indeed, physicians can be particularly valuable contributors in such discussions because of their ability to evaluate the way scientific information and anecdotal experiences are used to support or to refute particular points of view.

When providing medical opinion to pregnant workers, however, physicians should base their recommendations on objective clinical judgment of the available information. They should resist any pressure to modify them to gain their patients -- or to deny them -- any monetary or other benefits. The purpose of the physician's recommendations is to protect the health of the pregnant worker and her fetus.

III. Peri-Conceptional Hazards

The exposure of men and women to environmental hazards and drugs during the peri-conceptional period has been associated with genetic abnormalities which are generally not detectable prenatally, including spontaneous abortion, stillbirth, congenital malformation, and carcinogenesis in the child's later life. In some cases, such as exposure to lead, mercury and ionizing radiation, a relationship is relatively well established.[5] In others, the relationship is strongly suggested by epidemiologic studies as in recent studies of women exposed to anesthetic gases in operating rooms.[6] Data on abnormalities in the infants of male anesthesiologists suggest that this may be a problem for both sexes.[7] Finally, many substances have been shown to produce genetic abnormalities in laboratory preparations and experimental animals, but there is no evidence that they produce similar effects in humans.

The mechanism of these toxic effects is not well understood: most pregnancy attrition is idiopathic, some is hereditary and research has revealed only a few proven teratogens. Where a teratogenic effect has been demonstrated experimentally, the magnitude of the toxic exposure required to produce it in the laboratory has often exceeded the levels ordinarily encountered in the work situation. Experiments with lower levels have not always been conclusive. It is frequently not known whether a phenomenon always occurs, or occurs only after a toxic exposure of sufficient intensity and duration at a strategic phase in the development of the germ cells of the embryo. Further, the effects are not uniform: one substance may cause a variety of effects, while a particular effect may be produced by a variety of exposures. Consequently, the correlation of a given exposure with a genetic abnormality in a population does not necessarily prove a causal relationship in any individual case.

Because of these uncertainties, some persons contend that women of childbearing age should not be hired for work involving any exposure to hazardous substances. Others suggest that this exclusion be limited to women planning to have children. Citing evidence of vulnerability of males to such effects, some would extend these exclusions to individuals of both sexes who are able to have children. Others would require the employer to eliminate totally from the work place all exposures suspected of harmful effects, regardless of practicability and cost.

The lack of definitive knowledge makes it difficult for the practicing physician to provide meaningful advice when consulted by a working woman or man planning to have a child. This document helps the physician identify and evaluate the exposures involved in the patient's job, and lists resources to consult for the most current information about them.

IV. DATA BASE

A. Assessment of Work Exposures

Physicians practicing obstetrics have customarily included the patient's medical history, previous obstetrical history, and observations of the current pregnancy as part of their data base for managing the pregnancy. Information protocols, questionnaires, and medical record forms have been developed to facilitate the attending physician's effort.[8]

When the woman is employed, information on the work activity, including physical stress and chemical exposure, is essential for the initial obstetrical data base. This should be obtained by interviewing the pregnant woman at the first prenatal visit and reconfirmed by inquiry at each subsequent visit. She is closest to her job and often can provide most of the information needed by the physician.

Sometimes, however, the pregnant worker cannot provide accurate and complete information about the job and its environment. She may not be fully aware of the potential hazards, or may understate them. The experienced worker may often ignore the hazards that have become familiar. Job titles alone are usually uninformative because similar titles often encompass quite different exposures.[9]

Accordingly, a detailed inquiry about the work and the occupational environment is important. This may be done by a physician, a nurse, or a physician's assistant, or a questionnaire can be designed to be completed by the patient. In some instances, the patient's responses should be augmented by information obtained from other sources with the patient's permission, such as from the physician, nurse, or industrial hygienist in the company's employee health unit, the plant safety director, or the union representative.[10] When available, environmental monitoring data should be requested to establish the level of the exposure to which the worker is subjected. If she is part of a health surveillance program with biological monitoring (e.g., blood studies for lead), the test results will be useful.

It may be helpful for the woman to keep an hourly diary for several days, noting all of the tasks performed and materials handled. The assistance of her supervisor may make the data more complete and reliable. This is often remarkably revealing not only to the physician but to the pregnant worker as well.

Assistance in interpreting the information obtained and in determining the potential toxicity of the exposures to which the pregnant worker is subjected also can be obtained directly from occupational health professionals in the company or elsewhere, or from the NIOSH and OSHA consultants in the regional offices.[11]

Physical effort required by the job often is of concern. Few jobs require long sustained periods of continuous activity, and high energy outputs are usually required only for brief periods of time. Often a pregnant worker may continue to do heavy work by simply eliminating peak efforts and

varying the rhythm of the work-rest cycles. The knack of the job--the rhythm and coordination that comes with long practice--will sometimes make it less stressful to continue on a moderately strenuous job than to change to a less demanding one that is unfamiliar. Physical conditioning determines the amount of physical work one may safely perform: a person accustomed to moderately strenuous activity is generally able to perform it without excessive energy expenditure.

Pregnant women usually can continue to perform the physical activities to which they have been accustomed. However, pregnancy is an inappropriate time to change to a new or unfamiliar level of activity unless the woman undertakes a carefully supervised program of physical conditioning. Reconditioning may also be indicated before resuming work following an interruption that resulted in deconditioning, such as a medical complication or delivery.

While the focus of this document is the work environment, it must be emphasized that the woman's activities and exposures at home and in the community are also important. These should be examined and considered as carefully as her work exposures because they may involve greater levels of physical activity or more hazardous environmental exposures than those of the job. It is inconsistent, for example, to recommend that the job be modified to eliminate lifting heavy or bulky objects while allowing similar home activities like lifting groceries or laundry. It is also inconsistent to focus on environmental hazards at work while paying no attention to self-medication or use of potentially toxic household chemicals.

Attention should be paid as well to the stress of commuting to and from the job. Using public transportation in crowded cities frequently involves a burden greater than specific job responsibilities.

Pregnancy alone does not ordinarily increase the woman's susceptibility to emotional stress. However, the fatigue often experienced at different times during pregnancy may be compounded by the stress of jobs involving unremitting pressure, frenetic activity, or high levels of alertness and vigilance. On occasion, uncaring or even hostile attitudes toward the worker's pregnancy on the part of a supervisor or coworker may create a needlessly stressful work climate. These may often be helped by recommending more frequent rest periods and appropriate counselling.

Finally, the physician should pay careful attention to the patient's diet [12] and personal habits (smoking, alcohol use) and her use of medications. [13] These may add to or potentiate innocuous job exposures to the point of hazard to woman or fetus.

With these principles in mind, the attending physician should assemble and evaluate the necessary information. This is facilitated by a question format such as the one which follows.

B. Questions for Occupational History

This format may be used for assembling data about the employed patient and her partner to supplement the usual obstetrical history and home information.

1. Type and Place of Work:

	Patient	Male Partner
Job title:		
Employer:		
Union:		
Supervisor:		
Occupational Health Staff:		

This identifies the patient and persons for contact for further information. It is intended to augment the usual identifying and demographic data with information about the job setting.

Information about the male partner is important if he is a potential carrier of toxic substances or infection.

2. Work Schedule:

Inquire about days worked, hours worked, schedule changes, frequency and amount of overtime, rest periods and breaks, frequency and regulation of work flow.

This establishes the duration of work and the regularity of the work schedule. If rest periods are taken, ask whether these are on schedule or taken as needed. Adverse effects often can be obviated by altering the work schedule or changing the work/rest ratio. The flexibility of work flow is often important: can the woman set her pace, or is it dictated by a process like assembly-line work? Are there busy and slack times or is the pace steady?

3. Amenities:

Inquire about lavatory, rest areas, food and drink, access to emergency care.

This establishes the availability and accessibility of amenities that may be of special importance to pregnant workers. Can she go to the lavatory as needed? Is there a place to rest? To dine? Can arrangements be made for additional meals or rest periods as advised?

4. Physical Work:

Inquire about the nature of the activity, particularly sitting, standing, and other activities (such as walking, bending, climbing).

This establishes duration of continuous activity in hours and minutes, and the frequency per period in which these activities are performed.

Continuous sitting may affect lower spine and venous return. Type of chair and availability of footstool are important. Bar-type chairs may be used to relieve the standing worker.

Inquire about the nature of the load handled by the worker.

This establishes the force (weight) required, size and shape, and type of handling such as lifting or pulling.

Inquire about task characteristics, including the balance and coordination required, risks of falling, task complexity, agility required by moving machinery or objects, sudden starts and stops, belts and harnesses.

This establishes information about any possible hazards related to the possibility of falling, either as a result of impaired balance or dizziness in pregnancy, or because of use of ladders or precarious positions. The risk of being struck or of the abdomen being impinged between spine and an external object is important.

5. Environmental characteristics

Inquire about exposure to important environmental factors such as
- climate, temperature
- barometric pressure
- noise, vibration
- radiation
- biologic agents
- airborne dusts, fumes, vapors
- chemicals
- special job characteristics

This establishes exposure to toxic factors in the environment. Each of these is discussed in more detail with respect to specific reproductive and systemic effects elsewhere in this document.

Note the intensity – if possible in actual measurements – and the duration of the exposure.

Also note any special job characteristics that may reduce or increase exposures: occlusive garments, ventilation, close quarters, isolation, available emergency equipment or transportation, emotional stress.

C. Recordkeeping

If the physician notes items that may threaten the patient's safety or comfort, these should be highlighted either in a special list or by circling or underlining them. They will fall into the following categories:

1. Those about which more information is required. For example, there may be a known toxin at the work place, but it is not clear if the patient is exposed to it or at what levels; or, the patient is exposed to a substance about which the physician has no information.

2. Those about which the patient is needlessly concerned and for which reassurance may be given.

3. Those that present no great hazard, but threaten the patient's comfort, or make her work needlessly burdensome. The physician may make suggestions such as changing a chair, rearranging work objects or tools, modifying work flow to allow rest periods.

4. Those that warrant no concern at the moment but which might present problems later in pregnancy. These should be marked for later attention, and if possible, plans made for job modifications to obviate them.

5. Those that arouse concern about the safety of woman or child and which must be eliminated or controlled by modifying the job or its environment, or changing to a different kind of work. Here it may be necessary for the attending physician to communicate directly with appropriate representatives of the company and/or union (with the patient's authorization), to discuss the feasibility of the necessary modifications, and to make sure that they do not present other new hazards.

The exercise of building an occupational data base to augment the obstetrical history should stimulate the physician's scientific curiosity and highlight important information. This is important not only for analyzing experience of the pregnant worker, but also for detecting the possible effect of the male partner's exposures to hazardous substances. This could be of value in future epidemiologic studies of abortion, stillbirth, birth defects, and latent effects (e.g., transplacental carcinogens or developmental defects) that may be related to the woman's or male partner's exposures.

With the informed consent of the patient, any adverse symptoms or evidence of untoward effects that may be job related should be documented and explored with the employer and/or union. The aims are to verify the existence and magnitude of possible hazardous exposures (e.g., using resources such as NIOSH) and to encourage the patient to seek action to eliminate or control the risk (e.g., through management or labor channels, OSHA, or other applicable agency).

Finally, the physician's recommendations to the patient should be given in written form to the pregnant worker to help her understand and use them.

D. Interprofessional Relations

In some instances, particularly in larger companies, the pregnant worker has access to an employee health unit maintained by the employer or a union. With the woman's permission, contact with the health professionals in such units can be helpful to the physician managing the pregnancy.

Occupational physicians and nurses are usually familiar with the demands and exposures of the job and its potential hazards. Their records of prior examinations and treatments can supply useful information about the patient's health status, response to medications and treatments, and history of adverse effects from occupational exposures. They can often help arrange job modifications to permit the patient to continue to work. They can further assist the attending physician by observing the woman between appointments and reporting any significant signs or symptoms.

On occasion, occupational and attending physicians may differ in their evaluations with respect to the extent of a hazard or a patient's ability to continue at a particular job. The attending physician may be relatively unfamiliar with the potential hazards of the job and the ways in which they might be controlled, causing him or her to be overcautious. Conversely, the occupational physician's relative unfamiliarity with the physiology and the management of pregnancy may lead to an underestimation of the risks to which a particular patient might be exposed. In most instances, discussion of the specifics of the case will not only be mutually enlightening but will lead to more valid and effective advice to the patient.

V. THE MEDICAL CARE OF THE PREGNANT WORKER

A. Types of Recommendations

The goal of medical management is to counteract or minimize risks to the mother or fetus, enabling her to remain on the job without concern for as much of the period of pregnancy as possible. With infrequent exceptions, the following is a caveat:

> The normal woman with an uncomplicated pregnancy and a normal fetus in a job that presents no greater potential hazards than those encountered in normal daily life in the community may continue to work without interruption until the onset of labor and may resume working several weeks after an uncomplicated delivery.

The physician makes certain basic recommendations to the woman at each prenatal visit, reflecting medical judgment of a composite of concerns for the health of the woman or fetus, complications of the pregnancy, or job-related threats to the health and safety of the woman or fetus. These recommendations may be divided into the following categories:

1. The woman may continue to work without change. This should be applicable to most pregnant workers.

2. The woman may continue to work but with certain modifications of environment or activity. These modifications may fall into two categories:

   a. Desirable Modification

   The available evidence suggests that a modification of the work activity or environment will contribute to the worker's safety or comfort as she continues the activities of her daily life.

   b. Essential Modification

   The seriousness of the potential effect and/or the probability that it will occur is such that a modification of occupational environment, activity, or location is necessary.

3. The woman should not work. The physician's judgment is that any work is detrimental to the health of the pregnant worker or fetus.

Proper planning and action by the pregnant worker, and her family, and their employers are facilitated if recommendations specifically describe the job modification and the length of time it should be in effect. Moreover, to be consistent, these recommendations should extend to the woman's nonwork activity and environment.

B. Effective Periods of Recommendations

Any recommendation should be applicable only for a limited time period.

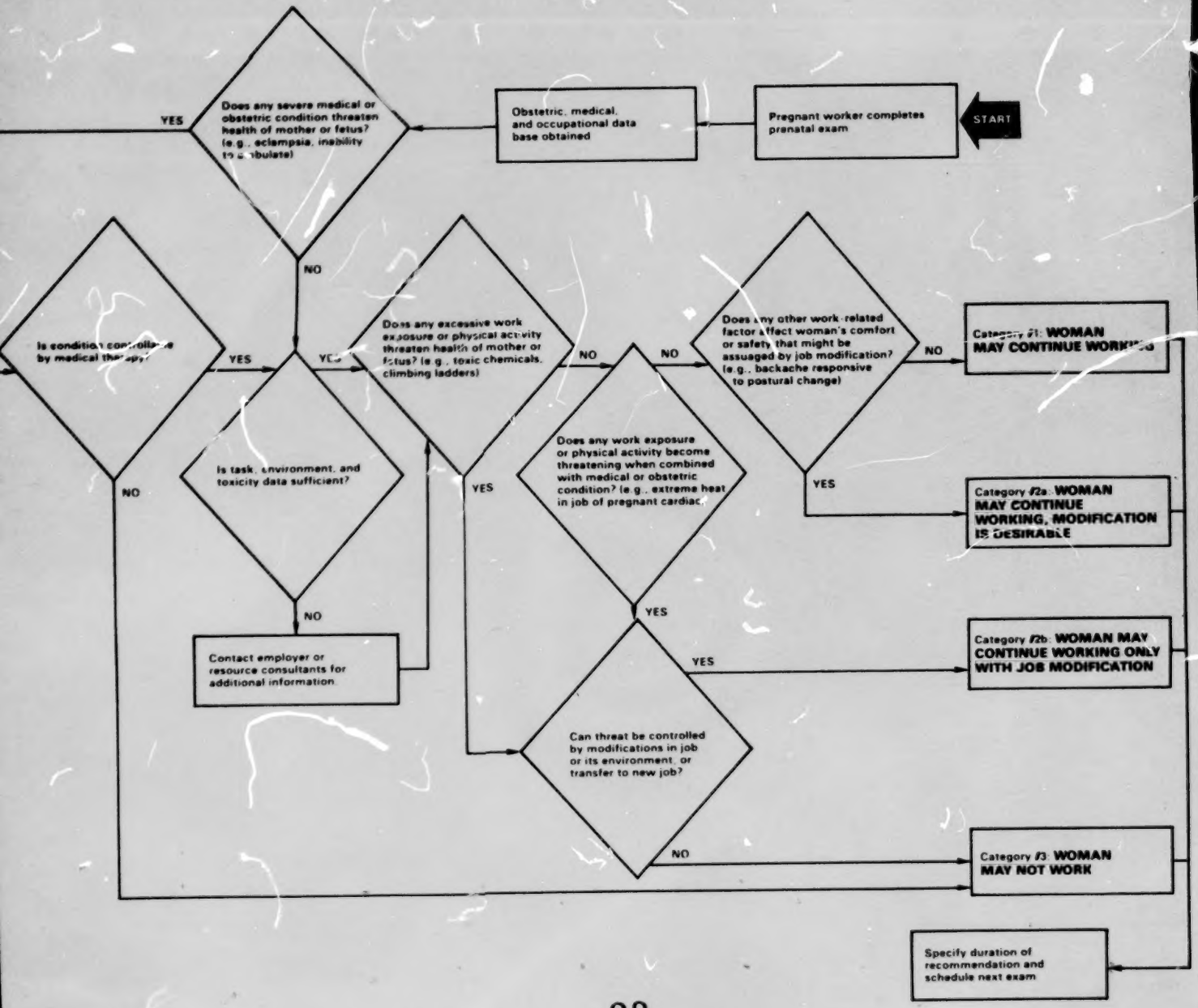
After an appropriate interval, the situation must be reassessed. The recommendation therefore includes notation of:

1. Next scheduled reassessment. The time should be indicated when the recommendation is to be reevaluated.

2. Projected duration of the recommendation. The recommendation may be of short duration, reflecting difficulty at a particular point in pregnancy or a problem that can be overcome by appropriate treatment. In some instances, it may extend through the rest of the pregnancy, reflecting either a sequence of independent problems or one that cannot be readily overcome.

C. Logic Sequence

On the following page is a schematic representation of the steps for developing recommendations for the pregnant worker.


START
Pregnant worker completes prenatal exam
Obstetric, medical, and occupational data base obtained
Does any severe medical or obstetric condition threaten health of mother or fetus? (e.g., eclampsia, inability to ambulate)
YES
NO
Is condition controllable by medical therapy?
YES
NO
Is task, environment, and toxicity data sufficient?
YES
NO
Contact employer or resource consultants for additional information
Does any excessive work exposure or physical activity threaten health of mother or fetus? (e.g., toxic chemicals, climbing ladders)
YES
NO
Does any work exposure or physical activity become threatening when combined with medical or obstetric condition? (e.g., extreme heat in job of pregnant cardiac)
YES
NO
Can threat be controlled by modifications in job or its environment, or transfer to new job?
YES
NO
Does any other work-related factor affect woman's comfort or safety that might be assuaged by job modification? (e.g., backache responsive to postural change)
YES
NO
Category #1: WOMAN MAY CONTINUE WORKING
Category #2a: WOMAN MAY CONTINUE WORKING, MODIFICATION IS DESIRABLE
Category #2b: WOMAN MAY CONTINUE WORKING ONLY WITH JOB MODIFICATION
Category #3: WOMAN MAY NOT WORK
Specify duration of recommendation and schedule next exam

D. Chart of Toxins and Effects

The following chart depicts various agents found in occupational exposures and which have been associated with actual or potential reproductive or systemic effects.[14] However, the list is not a complete inventory of proven or suspected agents.

The systemic toxicity shown is primarily from the findings reported in humans. The data on reproductive effects are from human and/or animal research. The exposure standards are those existing or proposed at the present time and may be changed as more information becomes available. Further information about the substances in this chart or other substances not listed can be obtained from the resources and contacts listed in the Appendix.

CHART OF TOXINS AND EFFECTS

AGENTS	DEFINITIVE SYSTEMIC TOXICITY: Neurologic	Hepatic	Renal	Hematologic	Cardiovascular	Pulmonary	SPECIAL EFFECTS	SUSPECTED REPRODUCTIVE EFFECTS: Carcinogenesis	Reduced Fertility	Spontaneous Abortion	Mutagenesis	Teratogenesis	SUGGESTED BIOLOGICAL TESTING	AIR STANDARDS*: OSHA (existing)	NIOSH (proposed)
Heavy metals															
Cadmium		•	•	○	•	•		•	○			•	Urine cadmium Quant. low molecular weight proteins	fume 0.1 mg/M³ dust 0.2 mg/M³	40 μg/M³
Lead	•		•	○					○	•		•	Blood lead** Blood zinc protoporphyrin Urine ALA Urine coproporphyrin	inorganic 0.2 mg/M³ (Proposed 0.1 mg/M³)	inorganic 0.1 mg/M³ and Blood Lead 60 μg/100gms
Mercury	•		•							•		•	Blood mercury Urine mercury	inorganic 0.1 mg/M³ organic 0.01 mg/M³	inorganic 0.05 mg/M³
Organic solvents															
Benzene (benzol)	•			•				•				•	Urine phenols CBC	10 ppm (emergency proposed: 1 ppm)	1 ppm
Halogenated hydrocarbons															
2 chlorobutadiene (chloroprene)	•	•	•	•		•		•	○	•	•	•	Liver function test	25 ppm	1 ppm
Dibromochloropropane		•	•					•	○				Sperm count Serum testosterone	10 ppb (emergency proposed)	10 ppb
Epichlorohydrin		•	•			•			○				Liver function test	20 mg/M³	2 mg/M³
Ethylene dibromide		•	•			•		•	○					20 ppm	1 mg/M³
Polychlorinated biphenyls (PCB's)			•		•		Chloracne	•	○	•			Blood analysis Adipose tissue Serum transaminase	Compounds with 42% chlorine 1 mg/M³ 54% chlorine 0.5 mg/M³	1 μg/M³
Tetrachloroethylene (Perchloroethylene)	•	•				•		•			•	•		100 ppm	50 ppm
Vinyl chloride	•	•			•		Acrosteolysis	•			•		Liver function test	1 ppm	1 ppm
Hypoxic agents															
Carbon monoxide	•			•	•							•	Carboxy hemoglobin	50 ppm	35 ppm
Anesthetic gases															
Halogenated gases e.g. halothane methoxy fluorane	•	•						•	○	•	•	•		not specified	Halogenated anesthetics 2 ppm based on weight of specific gas sampled not >1 hour
Pesticides															
Carbaryl	•								•					50 mg/M³	50 mg/M³
Chlorinated hydrocarbons (e.g. chlordane)					•			•			•		Adipose tissue analysis Blood analysis	varies with specific compounds e.g. Chlordane 0.5 mg/M³	
Chlordecone (kepone)	•	•					Pleuritic and joint pains	•	•				Blood analysis	emergency standard 1 μg/M³	1 μg/M³
Estrogenic compounds															
Diethylstilbestrol						•		•	•			•	Blood analysis	not specified	not specified
Ionizing radiation (Whole body)															
X-rays and gamma rays					•		Gastro-intestinal disorders	•	•	•	•	•	Personal film badge dosimetry Thermoluminescent dosimetry	NCRP recommendation 1.25 rad/quarter, 5 rad/year Pregnancy: 0.5 rem/full pregnancy	
Miscellaneous substances															
Carbon disulfide	•					•	Retinopathy		•	•		•	Urine iodine-azide test	20 ppm	3 mg/M³
Ethylene Oxide					•	•					•		CBC	50 ppm	50 ppm

- Animal and/or human data
- Time weighted average 40-hr. week, 8-hr. day (OSHA), 10-hr. day (NIOSH)
- In pregnancy, blood lead less than 40 μg/100 gms is suggested
- Evidence only male infertility; no data on females

VI. SYSTEMS REVIEW OF PREGNANCY AND WORK

A. Introduction

Multiple organ systems evolve and change throughout gestation. This section presents an examination of these physiologic changes by trimester, followed by a detailed systems review of normal pregnancy, complications, and environmental factors.

1. First Trimester (1 - 12 weeks)

The degree to which the symptoms of early pregnancy affect the individual is quite variable, and often is influenced by the general health and psychological state of the woman. Nausea and vomiting may be absent or may be severe enough to warrant hospitalization.[15] Some fatigue is almost always present.[16] Swelling and tenderness of the breasts are often evident.[17] Headaches and increased frequency of urination are less common.[18]

There are gradual but progressively significant changes in the maternal systems during the first trimester. About 0.65 kilograms of total body weight is gained during the first trimester. Although the total blood volume reaches its peak at 20-28 weeks, most of the increase occurs in the first trimester.[19] Cardiac output parallels this increase. There is also a progressive increase in the ventilation rate from a nonpregnant average of 7 liters per minute to an average of 10 liters per minute by term.[20] This state of hyperventilation means the pregnant woman may inhale greater quantities of agents from the air than when she is not pregnant. By the end of the first trimester, the renal system shows a markedly increased glomerular filtration rate (50% above nonpregnant levels) and an increase in the renal plasma flow (25-50% above nonpregnant levels).[21] At that time the uterus has enlarged to about 12 cm in diameter and is just beginning to become an abdominal organ.[22]

2. Second Trimester (13 - 28 weeks)

Although the most marked changes of pregnancy occur in the second trimester, the woman usually feels better and has fewer symptoms. The breasts hypertrophy with enlargement of the nipples and areolae.[23] The uterus rises about 28 cm above the symphysis pubis; its bulk tilts the body forward and gradually accentuates pelvic lordosis and thoracic kyphosis.[24] Increased mobility of symphyseal and sacroiliac joints becomes apparent and the woman may increasingly experience low back discomfort and stiffness.[25] Weight gain of about 7.0 kilograms is usually reached by the end of the second trimester.[26]

The gastric emptying time is delayed and constipation is common, due to hypomotility of the entire gastrointestinal tract.[27] At about the fourth month, the ureters dilate and become hypotonic, probably secondary to the generalized smooth muscle relaxation due to increased levels of progesterone.[28]

Many women experience dizziness and some have syncope with pro-

longed standing or working in hot environments. This is attributed to decreased cardiac output resulting from lowered venous return from the legs and the dilation of peripheral vessels to dissipate body heat.[29]

3. Third Trimester (29 - 40 weeks)

Almost all of the physiologic effects of pregnancy have stabilized at their new levels by the end of the second trimester, and continue relatively unchanged until term. The major changes noted are the progressive enlargement of the uterus and the reaching of an average total body weight gain of 11.0 kilograms.[30] There is a tendency to retain fluids: peripheral edema is frequently present reflecting decreased venous return from the legs due to the pressure of the uterus on the pelvic veins.

Fatigue, dyspnea, and insomnia result from the combination of the effects of weight gain, the increased respiratory requirements (with an increasing tendency toward an oxygen debt), and the general discomfort of managing a relatively more bulky and awkward body. Balance and equilibrium become problems in most activities. General myalgias, due to stretching of the abdominal musculature, may occur. The use of unfamiliar muscles to maintain balance and the relaxation of pelvic ligaments may also result in low back pain.[31]

Constipation, hemorrhoids, and varicose veins often make the individual uncomfortable. As term approaches, the fetal presenting part may lie deep within the pelvis and cause pressure on the base of the bladder resulting in frequent urination or incontinence.

4. The Postpartum Period

The puerperium begins after delivery of the placenta. During this period, involutional changes occur in the organ systems.

The blood volume returns to nearly the nonpregnant level within the first two weeks postpartum.[32] The pulse is variable but often low immediately following delivery, after which it rapidly returns to the normal range. The cardiac output increases an average of 35% over normal pregnancy values in the immediate (1 hour) puerperium. The ureteral dilatation and peristaltic movements of the ureter may persist until 12 weeks postpartum. Weight loss averages about 12 pounds at delivery with another four pounds lost in the puerperium.

The uterus decreases to 15 cm initially and reaches the nonpregnant size by the 12th day. The lochia gradually decreases over about four weeks, but six to seven weeks are required for the complete healing of the placental site. Episiotomies or vaginal tears heal quickly in one to two weeks in the absence of infection.[33] Full return to usual abdominal muscle tone occurs within four to six weeks. The breasts produce milk during the first few days, unless prevented by medications or binding. With the onset of lactation, swelling and tenderness of the breasts may increase. Many drugs and chemicals inhaled or ingested by the mother will appear in the milk immediately or over time and be passed to the infant.[34]

It should be noted that the immediate postpartum period is important for the emotional bonding of the family unit.[35] Such social and familial issues, however, are beyond the scope of this publication.

5. General Physical Condition

Pregnancy is a physiologic state during which most women are healthy. Complications and hazards are rare: some are discussed in the following sections. However, certain factors of the pregnant woman's general physical condition also have an impact on reproductive capability.

a. Age

Very young pregnant women tend to deliver prematurely and to have low birth-weight babies.[36] It is unclear whether this is strictly due to age or other factors such as nutrition. These poor outcomes often may be reduced by improved prenatal care. Special arrangements to encourage young pregnant workers to accept proper care are desirable.

Pregnant women over 35 years old have an increased rate of fetal chromosomal abnormalities, warranting genetic counseling, amniocentesis, and prenatal genetic diagnosis.[37] Older pregnant women also have increased numbers of complications in pregnancy, including hypertensive states of pregnancy and abruptio placentae. Older patients may require more rest.

b. Weight and Nutrition

An inadequate weight gain during pregnancy is almost always due to inadequate dietary intake and usually has little to do with work activity. Currently, it is recommended that a woman gain 10-12 kilograms during pregnancy.[38] A well-balanced diet, including at least 75 grams of protein per day, should be maintained. A more common problem is obesity, defined as more than 20% above standard weight for height. Obesity and excessive weight gain during pregnancy may interfere with activity and are associated with increased likelihood of dystocia, fetal distress, birth trauma, and large birth weight.[39] Finally, anemias and other nutritional deficiencies may diminish the patient's resistance to infection and toxins and impair her ability to perform physical tasks.[40]

c. Smoking, Alcoholism, Drug Abuse

Smoking is a risk to the fetus. The offspring of smokers are smaller and are subject to higher perinatal morbidity and mortality. Pregnant women should not smoke and should avoid high concentrations of the cigarette smoke of others.[41]

There is a higher incidence of anomalies in the offspring of alcoholic mothers. The fetal sequelae of alcoholism and drug abuse are serious. Women should limit alcohol intake in pregnancy.[42] Women with a history of drug abuse or Methadone maintenance warrant special care programs.

d. Need for Prenatal Care

It is critical that the pregnant worker be allowed adequate time to obtain her prenatal care, including educational programs, an amount that varies from woman to woman. Time away from work, however, may affect the woman's job status; especially when accompanied by loss of pay, this may be a deterrent to the prenatal care program. Arranging prenatal visits outside working hours, flexible work schedules, and observation by occupational health personnel in the work setting are helpful alternatives.

B. Reproductive System

1. Normal Pregnancy

Blood gases, electrolytes, and chemicals with a molecular weight under 700 generally cross the placenta rapidly by simple or facilitated diffusion or by active transport. Some larger molecules, such as proteins, cross the placenta by means of pinocytosis. Ionization, concentration gradient, molecular size, lipid solubility, and protein binding are factors that determine whether the molecule will cross the placenta and the speed of such transfer. Generally speaking, small, uncharged, unbound, lipid-soluble molecules will cross the placenta rapidly.[43]

The maternal-fetal exchange of nutrients and essential gases largely depends on the blood flow to the uterus and placenta. At term, most of the uterine blood flow is directed through the intervillous space of the placenta. Therefore, interference with uterine blood flow, uterine vascular narrowing or vasoconstriction, and uterine contractions will decrease the exchange of essential substances between the mother and fetus. The substantially higher umbilical and systemic blood flow rate and hemoglobin content of the fetus assist in maintaining an adequate oxygenation under normal conditions. The many other factors that may determine the amount of stress the fetus can tolerate without sequelae are largely unknown.[44]

2. Reproductive Complications

a. Reproductive Failure

Women with bleeding early in pregnancy diagnosed as threatened abortion are frequently advised to decrease activity or rest in bed, although such limitation of physical activity has not been proved to improve the outcome of pregnancy with threatened abortion.

It is unlikely that continuation of usual activity has much effect upon the incidence of spontaneous abortion in women with early bleeding; however, it is unwise for the woman to initiate unusually strenuous activity. Women with a history of recurrent spontaneous abortion, previous fetal anomaly, or prematurity, should have prenatal genetic counseling and diagnostic studies, and may require an increased number of prenatal visits.

b. Incompetent Cervix and Uterine Structural Anomaly

Women with a history of incompetent cervix require an increased number of prenatal visits (probably weekly) in the middle weeks of pregnancy. If the diagnosis is confirmed, hospitalization for a cervical

cerclage operation may be necessary. This diagnosis contraindicates activities which require very strenuous efforts, particularly those involving heavy lifting, unusual loading, repeated twisting, interruptions of rhythmic breathing, breath-holding, or Valsalva's maneuver.

Women with uterine anomaly have an increased incidence of spontaneous abortion, premature labor, malpresentation, and intrapartum difficulty.[45] They may require increased prenatal care, rest periods, and avoidance of all stressful physical activity.

c. Rh Isoimmunization

Patients with Rh isoimmunization require monitoring of blood antibody levels and serial amniotic fluid taps in the latter half of pregnancy. This requires frequent prenatal visits. On the day of amniocentesis, the woman should not attempt any vigorous exercise.

d. Hypertensive States of Pregnancy

Women with preexisting essential hypertension or with the hypertensive states of pregnancy may require decreased activity, rest at home, or hospitalization. They may undertake nonstrenuous work in the first two trimesters with careful surveillance on an ambulatory basis.

e. Diabetes Mellitus/Other Endocrine Diseases

The diabetic and her fetus are at increased risk. Control of diabetes is disturbed by alterations in carbohydrate tolerance, nausea and vomiting in the first trimester, increased metabolic rate, and fluctuating insulin needs. All these contribute to metabolic instability with frequent insulin reactions or hyperglycemia. Confusion, aimless hyperactivity, or other changes in sensorium may diminish the psychomotor abilities. This may threaten the safety of the woman or her coworkers.

Not only is the effect of pregnancy on diabetes deleterious, but the effect of diabetes on pregnancy poses special problems: there is greater risk of abortion, major neonatal anomaly, and complications of pregnancy (such as prematurity, infections, hypertension, fetal death and neonatal deaths). The frequency of poor outcome of pregnancy in severe diabetes mandates special evaluation of the work situation throughout pregnancy.[46]

The risks of hypoglycemia or hyperglycemia call for:

(1) Close proximity of coworkers and others to observe and assist the patient should acute problems arise.

(2) Training of coworkers and others to recognize emergencies and to provide emergency care.

(3) Ready availability of oral glucose preparations.

(4) Close proximity to medical facilities whenever possible.

Time away from work may be increased for these reasons:

(1) More prenatal visits.

(2) Time for counselling and special instructions.

(3) Hospitalization for long intervals. Many current treatment regimens require prolonged hospitalization to facilitate diabetic control.

(4) Occasionally, a 24-hour urine collection for estriols.

(5) Challenge testing.

f. Maternal Stress

The fatigue of pregnancy, combined with the physical demands of work and home responsibilities, may affect the ability of some women to cope with physical demands. Extremes of weather, malnutrition, disturbed sleep, anemia of pregnancy, and other complications exaggerate this problem; however, most women are able to continue working through most of pregnancy with some modification of the work schedule. In some cases, discontinuation of work is indicated by compounded fatigue. Individual judgment is required to evaluate fatigue and the need for increased rest.

The effects of pregnancy, fatigue, and work demands may also contribute to psychological or emotional stress in the mother. On occasion, this may affect her ability to adapt to change in the job or home, or to the demands of her pregnancy.

g. Poor Fetal Growth

Although intrauterine growth retardation may have little to do with the work environment in most cases, it poses such a risk that modification of activity, diet, and environment is frequently recommended. Increased rest may be advisable, and when poor fetal growth is diagnosed, women in occupations requiring much physical exertion should modify or discontinue their work.

h. Multiple Pregnancy

Patients with multiple gestation have an increased risk of premature labor and of intrauterine growth retardation.[47] Women with this diagnosis should limit their activity, should not perform strenuous physical tasks, and should probably be discouraged from working after the completion of the second trimester.

i. Recovery from Surgical Delivery

For the first week following an uncomplicated cesarean section, the woman is usually advised to do little more than care for her baby. From the second to the fourth postpartum week, she may resume light activity. By the end of the fourth week, she may perform tasks not involving heavy lifting or vigorous exercise, and can usually return to full capacity by six weeks. This is arbitrary, and should be individualized for each woman; many women re-

turn to full function earlier. Complications such as sepsis may considerably lengthen the period of recovery.

j. Recovery from Complicated Pregnancy/Delivery

Time for recovery varies considerably depending upon the individual patient. Patients with a medical complication of pregnancy generally require a prolonged recovery period. The scope and severity of the complications of labor and/or delivery determine the length of the recovery period. Generally, it is recommended that the woman do little more than care for her baby during the first five days. Then she may gradually resume her usual activities, reaching full capacity three to four weeks postpartum.

3. Environmental Factors

a. Radiant Energy (lasers, ultra violet, infrared, microwave)

It is unlikely that fetal harm from radiant energy would occur without the mother having been burned. In general, existing criteria for nonionizing radiant energy protection should be protective for pregnant women and the fetus.

b. Ionizing Radiation

Most workers occupationally exposed to ionizing radiation in medical and industrial settings wear film badges for dose monitoring. Badges are usually read quarterly to establish the dose accumulated during the previous three months. A worker generally has access to the records containing her personal dose exposure information. The woman who is able to plan her pregnancy could request a monthly badge reading to be sure that her radiation dose has remained within safe limits from the period immediately before the beginning of pregnancy and thereafter. The recommended dose limit for the embryo/fetus for the nine-month period is 0.5 rem (rad). This is equivalent to 1.5 rem (rad) to the pregnant woman because absorption of radiation by the abdominal wall usually reduces the fetal dose to 0.5 rem or less. If this dose is reached, protection of the worker from further exposure would be necessary for the remainder of the pregnancy. The dose from diagnostic x-rays should be added to the occupational dose to calculate the total radiation exposure.[48]

c. Biological Agents

Although susceptibility to infection does not seem to be increased in pregnancy, infection during pregnancy is likely to be more virulent. In certain diseases, the infectious organism may cross the placental barrier to exert a harmful effect on the fetus. This can result in early abortion, fetal death, fetal infection, or fetal abnormalities.[49]

Infection is also significant for the increased burden it places on the maternal physiology and the possible adverse effects of drugs that may be required for treatment. More time may be required for recovery. Consequently, the pregnant worker should be protected against undue risk of exposure to infections. For example, it might be unwise for a pregnant woman

to be employed in a contagious disease unit or in a bacteriology laboratory.

The timing of a viral infection relative to fetal organogenesis and the specific response of the fetus to the viral infection are critical for fetal outcome. Maternal viremia may lead to abortion or stillbirth. It may also be responsible for severe developmental defects, or evidence of neonatal infection. The more common virus diseases are: rubella, measles, mumps, herpes zoster, herpes simplex, influenza A-strain, lymphocyctic choriomeningitis, cytomegalic inclusion, hepatitis A (infectious), anterior poliomyelitis, coxsackie, smallpox, and chickenpox. Immunization, especially with live or attenuated vaccines, should be completed before pregnancy. Jobs which require continuing exposure to these viruses pose a special problem for the pregnant worker. Under ordinary circumstances, isolation of the pregnant worker from known cases is advisable.

The protozoan agents which cross the placental barrier causing congenital disease or persistent postnatal infection are toxoplasma gondii, plasmodia (malaria), and trypanosomes.[50]

d. Waste Anesthetic Gases and Vapors

Recent data suggest that there is a greater than ordinary incidence of congenital abnormalities in children born of women or to partners of men exposed to anesthetic gases. There may also be an increase in spontaneous abortion. A number of the halogenated hydrocarbons, including vinyl chloride and the freons, have structural and physiologic activity similar to the anesthetic gases and are being studied for such effects.

It has been suggested that even small quantities of the waste gases to which operating room personnel may be exposed may decrease perception, acuity and intellectual capacity.[51] It is not known whether exposure to these substances causes additive effects; however, it is known that the gases themselves are persistent, may build up, and do pass the placental barrier.

Properly designed and used low-leak anesthesia equipment attached to gas scavenging systems should provide adequate protection.

e. Heavy Metals

The heavy metals are capable of general systemic toxicity, including damage to nervous system, kidneys, and blood-forming organs. Certain metals have been demonstrated to be essential to life in mammals. Deficiencies of these metals (e.g., zinc, copper) have been associated with reproductive abnormalities in animals, but the effect in humans is not known.[52]

(1) Lead

The increased numbers of abortions and stillbirths among female workers expsoed to excessive lead levels have long been recognized, and children of such workers were found to be highly susceptible to neonatal convulsions.[53] High concentrations of lead have been demonstrated in the placenta, liver, and brain of stillborn infants born to lead workers.[54] Newborns of non-occupationally exposed women have been found with measurable quantities of lead

in their blood correlating well with the mother's blood lead level. Historic evidence of pregnancies fathered by males employed in the lead industry shows a greater incidence of spontaneous abortions and stillbirths. Recent data suggests an effect of lead on the male germ cells.[55]

Lead may enhance the toxic properties of certain medications; for example, it has been shown to potentiate the effect of lithium on the liver.[56] Lead compounds have been shown to be teratogenic and carcinogenic in animals.[57]

(2) Mercury

Inorganic and organic mercury has been known for some time to pass the placental barrier. Recent reports from Japan (Minimata disease) indicate that infants of women who ingested food contaminated with methyl mercury have damaged central nervous systems, kidneys, and other organs. Severe cerebral palsy and mental retardation have resulted in many cases.[58] Infants were found to be affected even when the mothers did not evidence clinical toxicity. In some breast-fed infants, exposure from ingestion of mercury-contaminated mother's milk added to the intrauterine exposure. Inorganic mercury used in the treatment of syphilis has been reported to be an abortifacient, and mercury has been found in the stillborn babies of treated mothers.[59]

(3) Other Metals

A number of metals are known to injure the immune response of the fully developed organism. For example, the oxidative metabolism of phagocytes is impaired by cadmium as well as lead.[60] These metals also decrease the elaboration of antibody in a variety of animals, including the mouse and rat. Pregnancy intensifies the pulmonary symptoms in women with berylliosis and in the past was associated with high maternal mortality.[61]

f. Persistent Organic Compounds

Recent experience with polychlorinated biphenyls (PCBs), polybrominated biphenyls (PBBs), kepone, dioxin, and mirex indicates that they can adversely affect reproduction.[62] Infants born to mothers with PCB poisoning from ingestion of contaminated cooking oil had decreased birth weights, and some showed brownish discoloration of the skin, indicating transplacental passage of the PCBs. These compounds are also transmitted to the newborn through nursing. If the woman has ingested these compounds in food, an abbreviated period of nursing may be suggested. If the exposure has been excessive, breast-feeding may be contraindicated.[63]

g. Halogenated hydrocarbons

Hepato-renal toxicity is most often associated with the many halogenated hydrocarbons. Familiar ones are tricholorethylene, perchlorethylene, vinyl chloride, tetra-chloro-dibenzo dioxin (TCDD), heptachlor epoxide, and oxychlordane. Very little is known about the effects of these chemicals in pregnancy. Pregnant women may be more susceptible to the effects, reflecting their increased metabolic rate.

Attention has been given recently to the association of these compounds with mutagenesis and carcinogenesis. In some studies, chromosomal aberrations have been found, and increased fetal mortality was noted among wives of vinyl chloride workers. [64]

h. Carbon disulfide

Although carbon disulfide is primarily a neurotoxin, several foreign studies have reported reproductive effects, including increased spontaneous abortion, threatened abortion, and infertility. Spermatic disorders in men have also been reported.[65]

i. Pharmaceuticals

Almost all pharmaceuticals and chemicals may cross the placenta and concentrate in the fetus; however, the effects of an agent may be negligible to catastrophic, depending upon (1) the agent and dosage administered, (2) the time of administration, (3) the duration of exposure, and (4) the genetic makeup of the mother and fetus. One critical period of drug risk is that of organogenesis (i.e., from the 13th to 56th day of gestation).

Most exposure to pharmaceuticals is in therapeutic use. But many women work in industries which manufacture or otherwise use these chemical agents in industrial processes. Occupational exposure is considerably more difficult to evaluate.

Many seemingly causal relationships between drugs and anomalies have not been clearly defined because it is difficult to account for intervening variables in clinical research. Consequently, some drugs may have been labeled "deleterious" merely because of coincidental association with a fetal condition.[66]

(1) Teratogenic Drugs

Thalidomide, the only proven example of an unquestionably teratogenic drug, was associated with the occurrence of phocomelia, or seal-limb deformity, in 6,000-8,000 children in Europe during the early 1960's.[67]

A recognizable pattern of growth retardation, microcephaly, and short palpebral fissures has been described in the offspring of chronic alcoholic mothers. Other anomalies of the joints, heart, and genital organs may be associated.[68]

Birth control pills administered during early pregnancy have been associated with a complex of anomalies involving the vertebrae, anus, heart, trachea, esophagus, and limbs of the fetus. Progestins and androgens have been associated with varying degrees of labioscrotal fusion and clitoral enlargement in the female fetus when taken during the first 18 weeks. Advancement of skeletal maturation has also been reported.[69]

Phenytoin sodium, primidone, trimethadione, and pheno-

barbital have been implicated as etiologic agents in a characteristic pattern of craniofacial abnormalities of the fetus.[70]

Methotrexate and other drugs are thought to produce craniofacial ossification effects in the fetus secondary to their antifolic acid effect. Other chemotherapeutic agents (e.g., chlorambucil, cyclophosphamide and mitomycin-C) are associated with a high incidence of abortion and fetal malformations.[71]

There are other agents with less clear evidence. Cardiac abnormalities (e.g., ventricular septal defect, mitral atresia, coarctation, tricuspid atresia, and Ebstein's anomaly) may be increased fivefold in patients taking lithium during pregnancy.[72] Haloperidal is a tranquilizer that has been implicated in two cases of limb deformity. Meprobamate, when given during the first six weeks, has been suggested as a cause of cardiac anomalies.[73] Chlordiazepoxide hydrochloride, given early in pregnancy, has been implicated as the cause of mental deficiency, spastic diplegia, deafness, microcephaly, and duodenal atresia. Dextroamphetamine may result in congenital heart defects.[74] Recently, warfarin therapy during pregnancy has been suggested as the cause of a syndrome known as the Conradi-Hunermann type of chondrodysplasia punctata.[75] Tetracyclines may accumulate in the fetal skeleton and result in enamel hypoplasia and staining of the deciduous teeth. Streptomycin treatment may result in eighth nerve damage and fetal deafness. From time to time, other drugs have been implicated as a cause of anomalies; however, the evidence is even more tenuous.

(2) Carcinogenic Effects

Only one group of drugs, the synthetic nonsteroidal estrogens (e.g., diethyl stilbestrol, dienestrol, hexestrol) when given prior to the fifth month, have been definitely linked to the development of adenocarcinoma of the vagina in the female offspring of mothers treated with these agents during pregnancy.[76] Over 250 cases of adenocarcinoma of the vagina have now been identified.

(3) Fetocidal Effects

Coumarin and hydantoins combined with phenobarbital cause a decrease in the Vitamin K dependent clotting factors (II, VII, IX, and X) and prolongation of the prothrombin time and/or the partial thromboplastin time. Salicylates also have been implicated in fetal hemorrhagic problems.[77] Thiazides, promethazine, and indomethacin also have potential adverse effects on the hemostatic mechanism and should be avoided in the third trimester.[78] Quinine, sulfonamides, and thioureas have been reported to cause thrombocytopenia in the newborn.[79] Ergotamine and similar ecbolic agents may jeopardize the fetus by producing tetanic contractions of the uterus leading to hypoxia or premature labor. Nitrofurantoin may theoretically cause hemolysis or hyperbilirubinemia.[80] Chloramphenicol, when given at term, may result in a high concentration of the drug in the fetus and the development of the "grey syndrome," which is manifested by cardiovascular disturbances, bone marrow depression, and peripheral vascular collapse.[81]

(4) Birth Weight Effects

Any drug that produces a teratogenic effect may also adversely influence the birth weight of the fetus. Smoking mothers have infants with significantly lower birth weights, averaging 200 grams lower than normal.[82] Corticosteroids may produce placental insufficiency, resulting in a low birth weight infant who may have hypoglycemia. Drugs of abuse (e.g., alcohol, narcotics, hallucinogens) are all associated with low birth weight infants; however, the generally poor nutrition of these mothers makes it difficult to determine a direct relationship. Ovulatory agents, such as clomiphene and human menopausal gonadotropin also may result in low birth weight infants, probably secondary to the induction of multiple births.

(5) Neonatal Adaptation Effects

Many drugs given in labor or excessive amounts of intravenous fluid may interfere with the immediate adaptation of the fetus to extrauterine life.

C. Cardiovascular System

1. Normal Pregnancy

The blood volume increases 30-40% beginning in the first trimester and peaks by the 32nd week. This change is caused primarily by the increase in plasma, although the red blood cells also increase about 33% above nonpregnant levels, secondary to an accelerated production.[83] This dilutional phenomenon has sometimes been referred to as a "physiological anemia of pregnancy." Theoretically, these changes should result in a decreased blood viscosity, but empirical evidence is lacking.

The cardiac output (the volume of blood ejected from the left ventricle per minute) parallels the blood volume changes, increasing from a nonpregnant level of 70 ml/min/kg to a pregnant level of 110 ml/min/kg, peaking at about 28 weeks. The total change of 30-35% over nonpregnant levels is due to both the increase in stroke volume and the increase of perhaps 15-20 beats/min in heart rate in the last trimester.[84]

There is a fall of 10-15 mm Hg in the diastolic pressure, but the systolic pressure may or may not drop slightly. This reflects one of the striking circulatory changes in pregnancy: the coupling of the low-resistance vascular bed of the placenta in parallel with the maternal circulation. This pressure shunt absorbs a major portion of the increased cardiac output. This also lowers the systemic vascular resistance causing changes in blood pressure.

The enlarging uterus presses on the inferior vena cava, causing the venous pressure to rise in the lower extremities, peaking at term.

The vasomotor tone of the circulatory system is usually determined by the intrinsic tone of the vessel walls and by humoral factors acting upon them. Pregnancy seems to increase the autonomic nervous system control, especially of the venous low pressure system. Any anesthetic or pharmaceutical

block of the autonomic system markedly reduces arterial pressure and causes signs of circulatory shock because of venous pooling, decreased venous return to the heart and decreased cardiac output.[85]

2. Cardiovascular Disease in Pregnancy

a. Rheumatic Heart Disease

Rheumatic heart disease is the most common cardiac problem in women of childbearing age. Mitral stenosis, usually the predominant valvular lesion, may obstruct blood flow from the left atrium to the left ventricle sufficiently to increase pressure in the left atrium. This increases pressure in the pulmonary veins and pulmonary capillaries, which is intensified by increases in cardiac output and pulmonary blood volume and tachycardia. Since pregnancy itself produces some of these changes, the woman with mitral stenosis is closer to pulmonary edema when she is pregnant. Women with advanced mitral stenosis will show pulmonary congestion early in pregnancy, reflecting the greater blood volume and demand for cardiac output.[86]

Even when mitral involvement is mild, it limits the ability of the heart to respond to the combined demands of pregnancy and physical effort. Accordingly, work should not be considered for pregnant rheumatic cardiac patients, except those whose ordinary physical activity need not be restricted and whose jobs do not require strenuous effort.

b. Congenital Heart Disease

Women with minor congenital heart defects should have no difficulty with pregnancy. Corrective surgery for patent ductus arteriosus, uncomplicated septal defects, and coarctation of the aorta is usually performed before childbearing age, so pregnancy is not of concern unless there is residual functional impairment.[87]

In pregnancy, women with Marfan's syndrome are at risk of dissecting aneurysm.[88] Such women should not work. Pregnancy is also extremely hazardous in women with pulmonary hypertension.[89] In these two conditions, pregnancy is actually contraindicated.

c. Cardiac Arrhythmias

Increased myocardial irritability associated with pregnancy makes premature atrial or ventricular contractions and minor supraventricular arrhythmias quite common. They are usually transient and inconsequential in the woman with a normal heart. Yet the anxiety they produce can be debilitating. When arrhythmias seem to be aggravated by work activity, several days rest may be indicated.

d. Hypertension/Renal Disease

Maternal complications are frequent in hypertensive women.[90] Approximately 15 to 35% of patients with chronic hypertensive disease develop superimposed preeclampsia or eclampsia; when this occurs, hospitalization or bed rest at home is necessary.

Hypertensive patients with definite systemic involvement (retinopathy more than Stage 1, cardiac or renal involvement) are at high risk during pregnancy and should undertake work only under close medical supervision. When hypertension is under control, a woman may continue her usual activity.

Pregnant hypertensives require frequent prenatal visits to detect increases in blood pressure or proteinuria. Special diets are usually prescribed.

The most common renal complication in pregnancy is urinary tract infection. Although it is now routine to screen for and treat asymptomatic bacteriuria, there is still a significant incidence of pyelonephritis during pregnancy. Except for brief hospitalization for treatment, work may continue.

e. Hematologic Disease

Except for anemia, blood dyscrasias are rarely encountered in pregnant women. Iron deficiency anemia is prevalent in women and, despite greater iron absorption, it may be aggravated by the increased maternal red blood cell mass and by fetal iron requirements. Complications of sickle cell and other congenital anemias may be intensified by pregnancy. Anemias should be treated promptly to restore the blood's oxygen-carrying capacity.[91]

Even when there is no anemia, the oxygen-carrying capacity can be compromised by exposure to carbon monoxide, methyl chloride, and chemicals producing methemoglobinemia. Although this may cause only minor symptoms in the pregnant woman, there may be more serious fetal effects. Accordingly, limitation of physical effort is usually advisable in pregnant workers whose oxygen-carrying capacity of blood is diminished.

3. Environmental Factors

a. Physical Effects

(1) Abnormal Temperature and Humidity

Extreme heat and humidity can be environmental or caused by occlusive garments and can lead to increased fatigue, discomfort, and other symptoms. These may produce an impairment of alertness, mental function, and physical capacity, requiring limitation of strenuous activity.[92] The circulatory derangements produced by heat that exceeds the body's thermoregulatory mechanisms are heat stroke and heat exhaustion.

The mother's body dissipates fetal body heat, about one degree higher than hers, and the heat produced by her own increased metabolic rate. Consequently, she is more sensitive to heat and humidity. The pregnant cardiac patient is even less able to cope with the increased circulatory demands produced by this exposure. Dizziness and occasional syncope are sometimes reported in pregnant women exposed to extreme heat or humidity, or when first exposed to heat.

(2) Barometric Pressure Effects

No adverse effects from altitude change have been noted in normal pregnant women in jobs involving travel via commercial aviation.[93] With pregnant cardiac patients, exposure to decreases in barometric pressure sufficient to produce relative hypoxia may be of concern.

b. Hematoxins

The hematoxic effect of chemicals is primarily interference with the oxygen-carrying capacity of the blood, resulting from a reduction in the number of circulating red blood cells with anemia as in the case of lead and benzol (benzene, to be distinguished from benzine); or with hemolysis as with arsine, stibine, and nitro-benzene. Such effects may be also generated through the interference with oxygen uptake by hemoglobin caused directly by carbon monoxide, methylene cloride and hydrogen cyanide. Methemoglobinemia occurs from the cumulative exposure to numerous nitrogen-containing compounds, such as aniline, nitrobenzene, and trinitrotoluene (TNT). This also causes newborn infants to have impaired nicotinic acid dinucleotide ($NADH_2$) methemoglobin reductase, which gives them a greater propensity to develop methemoglobinemia from these substances.[94]

D. Pulmonary System

1. Normal Pregnancy

During pregnancy, a state of maternal hyperventilation exists. The mother continually moves more air through the pulmonary system to extract a given amount of oxygen than she does when not pregnant. The hyperventilation is due to the progressive elevation of the diaphragm by the uterus and the increase in maternal oxygen consumption, estimated at 20-30% above nonpregnant levels.[95] Factors that change lung function or diffusion capacity of the alveoli (e.g. beryllium poisoning or excessive exposure to cotton dust) may seriously interfere with the oxygenation of the blood.

The anatomic changes in the respiratory system occur early in pregnancy and consist of rib flaring and elevation of the diaphragm. The ventilation rate of 7 liters per minute rises through pregnancy to a peak of 10. This is associated with a drop in arterial pCO_2 from 40 mm Hg to about 30 mm Hg.[96] Progesterone has been implicated as the cause for this hyperventilation.

Although tidal volume is increased during pregnancy, this is at the expense of the expiratory reserve volume, so that the vital capacity remains essentially unchanged. The decrease in the expiratory reserve volume and residual volume produces a much more efficient gas mixing during pregnancy.[97]

The total work of quiet breathing has been estimated to be 0.3-0.8 kg-m/min. The pregnant woman incurs a larger oxygen debt with exercise and physical activity than a nonpregnant woman. This increases gradually as pregnancy progresses.[98]

Early in pregnancy, capillary dilatation occurs throughout the respiratory tract leading to engorgement and erythema of the nasopharynx, larynx, trachea, and bronchi, often causing voice changes and complicating

nose breathing. The symptoms are markedly aggravated by minor upper respiratory infections and by dusts, pollens, or airborne irritants in the work environment.

The engorgement of pulmonary blood vessels is also noted on chest x-ray by increased lung markings resembling those seen in early congestive heart failure.

2. Pulmonary Disease in Pregnancy

a. Acute Respiratory Infection

Fever, fatigue, malaise, cough, and increased secretions usually accompnay the acute respiratory infection, producing a physiologic burden which may present difficulty for the pregnant worker. She is more likely to be incapacitated by a relatively mild upper respiratory infection and often will require longer recuperation than when not pregnant.

b. Allergic Diseases

Allergic rhinitis ordinarily presents no difficulty to the pregnant worker. However, because there may be reluctance to use antihistamines, and because topical vasoconstrictors have limited effectiveness, the pregnant worker may have some difficulty if the work environment is allergen-rich.

c. Bronchial Asthma

The respiratory burden of pregnancy is greatly increased by bronchial asthma--even mild attacks can be debilitating to the pregnant worker. Extra care should be taken to protect pregnant asthmatics from substances to which they are sensitive.

d. Pneumoconiosis

Pregnant workers with previous exposure to pneumoconiotic agents may have impairment of ventilatory and diffusing capacity.[99] This, when combined with the respiratory burden of pregnancy, may require restriction of activity.

e. Tuberculosis

The pregnant woman with tuberculosis may require considerable rest.[100] However, with modern chemotherapy some patients may be able to continue employment. The postpartum period is a time of hazard to the patient with tuberculosis. Prolonged therapy and surveillance during this time may delay the return to full capacity.

f. Pneumonia

With antibiotics, maternal death from pneumonia is rare in the absence of underlying chronic disease. Fetal mortality, however, approaches 30%.[101] The biological uniqueness of the fetus is underscored when pneumonia

complicates pregnancy. The impact of pneumonia on the developing fetus varies with the degree of (1) hypoxia, (2) possible hypoglycemia in conjunction with metabolic lactic acidosis, and (3) hyperthermia.

g. Berylliosis

The disease resulting from excessive exposure to beryllium has a particular effect on the pregnant woman: the respiratory rate increases markedly at the onset of pregnancy, even though the woman may no longer be exposed. High maternal mortality was observed in women exposed to beryllium in the mid-1950's.

3. Environmental Factors

a. Chemical Effects

(1) Asphyxiant Agents

In view of the increased work of respiration and greater oxygen demands, the pregnant worker is more susceptible to asphyxiant agents, which reduce the number of circulating red blood cells or interfere with oxygen uptake of hemoglobin. With her increased respiratory rate and tidal volume, the woman may absorb greater amounts of airborne substances than when not pregnant. This suggests that the usually allowable concentration of chemicals in the air should be reduced for the pregnant worker.

(2) Irritant Gases

Irritants such as acid fumes and smoke will produce cough and secretions and are thought to increase susceptibility to infection. They may also mechanically interfere with breathing. The respiratory demands of pregnancy reduce the worker's usual tolerance for these substances.

(3) Other Particulate Matter

The pregnant worker has a hyperemic bronchopulmonary system and is more sensitive to particulate matter and allergens such as flour, epoxy, pollen, and sawdust. Physicians should identify poorly tolerated substances and recognize that existing allergies may be intensified by pregnancy.

E. Musculoskeletal System

1. Normal Pregnancy

Pregnancy accentuates the lordosis of the lumbar spine and the kyphosis of the upper back. As the uterus rises and the breasts become heavier, the center of gravity moves backward in the lower portion of the spine and forward in the neck region, increasing the risk of falls and resulting in some loss of balance and equilibrium. These changes are associated with the weight gain of pregnancy and frequently result in the development of low backache.[102]

Both the symphyseal and sacroiliac synchondroses soften, separate, and become more mobile. Symphyseal separation averages 0.5 to 1 cm at term; however, separations of up to 5 cm have been reported. Patients with separation of over 1.5-2.0 cm frequently have pain and tenderness over the symphysis which radiates down the inner thighs. Sacroiliac mobility often results in low back pain, commonly unilateral, probably due to stretching of the ligaments about the sacroiliac joint.

Coccygodynia occurs most commonly following fracture of the coccyx, either in traumatic fall or during a previous difficult delivery. In the thin woman, however, changes in the spinal curvature may allow the coccyx to tip backwards resulting in pain when the woman sits on a hard surface.

Occasionally, at or near term, a large uterus or hyperactive fetus will accentuate the normal rib flaring and cause pain and soreness of the lower rib cage. This may be more severe if an associated scoliosis is present.

2. Orthopedic Disease

Generally, preexisting orthopedic problems tend to worsen during pregnancy. This may be because of changes in posture, changes in carrying angle, changes in pelvic rigidity, and possibly even due to ligamentous changes. Care should be taken that the patient with orthopedic difficulties has adequate prosthetic support to perform given tasks.

3. Environmental Factors

a. Ergonomic/Physical Energy Conditions[103]

Tolerance of strenuous exertion, such as lifting, pulling, pushing or climbing, will vary widely, depending on differences in the women's physical fitness and strength, the load handled, and the environment. The pregnant woman may be small, large, strong, or weak. Her strength, balance, agility and internal burdens change from month to month. Packages or loads also vary widely in size, shape, and consistency, from a bale of towels to a case of food, or a patient in a nursing home. The job may or may not permit modification of intensity, frequency, and pattern of its physical tasks. A detailed work history helps the attending physician recognize and understand these variables and offer useful guidance.

Any factors that might cause loss of appetite or excessive or chronic fatigue should be avoided--for example, extreme changes in daily routine or frequent changes of shift. Because many nonspecific symptoms are present during pregnancy (headache, backache, nausea) any change in routine that is likely to aggravate these should also be avoided.[104]

During the third trimester, it is recommended that the woman wear low-heeled shoes to lessen the shift of the weight-bearing angle. However, since many women are unused to low heels or flat shoes, they may be allowed to wear medium heels if they wish. Women should avoid high heels and shoes without adequate support because of the risk of slipping or falling.

Restrictions on the amount of weight to be lifted by women have generally been discarded by state regulatory bodies. Therefore, it is not lawful to set a limit on what a woman should lift, pregnant or not. If the woman can handle the load easily when not pregnant, chances are she will not be unduly stressed when pregnant. However, if the load is lifted in front of the body, the act of lifting may be more difficult in the last trimester due to the protruding abdomen.

In addition, the change in posture necessary to lift the load in front creates higher than usual stresses on the lumbar spine during pregnancy. If the load lifted before pregnancy required near maximum effort, it will exceed the woman's capabilities late in pregnancy. Therefore, if the woman is not to be overtaxed, the load must be reduced. The amount of load reduction can be calculated based on metabolic considerations: the amount of energy expended to lift a load should be the same, before and during pregnancy. Accordingly, a load that was maximum before pregnancy should be reduced 20% to 25% during late pregnancy.[105]

Another point to consider in the lifting and carrying of loads is body balance. After the 20th to 24th week of gestation, women become progressively more awkward. If they are not used to it, they should avoid work involving a strained posture or a good sense of balance.

Even a minor blow to the abdomen can damage the uterus or disturb the placental attachment. The unaccustomed abdominal protrusion and increased susceptibility to falls makes the pregnant worker particularly vulnerable. Climbing ladders should be avoided. Belts and safety harnesses usually present no difficulty if they are not constrictive.

Softening and extensibility of abdominal musculature and pelvic ligaments occur to varying degrees in pregnant women. It is thought that during the latter months of pregnancy these structures are more vulnerable to unusual loading, repeated twisting, or unexpected slippage on unstable surfaces. Therefore, pregnant women should not work in conditions where there is inadequate protection against slips or falls.[106]

Special attention should be given to the seated posture. It is necessary that the backrest of the chair be low enough to support both the lumbar and sacral area of the pelvis, and that the seat be wide enough to permit being seated with both legs in a semiabducted and supported position. A small footrest may be useful to avoid pressure upon the suprapopliteal region by the seat pan.

The pregnant woman should be allowed to perform her work standing or seated, with frequent postural changes, particularly in the last trimester. This requires special attention to work surface height. One suggestion is a high stool, matched to a fairly high workbench, so that work surface height does not change when seated and standing postures are alternated.[107] In providing this type of work place, however, care should be taken to assure that the legs are supported by a footrest when seated, because venous return from the legs could be compromised.

F. Neurologic System

1. Normal Pregnancy

There are no specific neurologic conditions that are attributable to pregnancy; however, pregnancy may have adverse effects upon various existing neurologic diseases.

2. Neurologic Disease in Pregnancy

a. Seizure Disorders

The most common neurologic complications seen during pregnancy are seizure disorders. Teratogenic effects may result from the disease as well as from the anticonvulsants used to control it.[108] Unfortunately, it is not possible in many cases to stop or decrease the medication during the course of pregnancy.

Convulsive disorders may occur with a greater frequency in patients who are psychologically stressed or disturbed. The hazard to the employed pregnant convulsive patient is increased numbers of seizures. Therefore, it may be best to limit the patient to occupational areas where the possibility of injury to herself or others is minimal and to verify that coworkers have been taught methods of assisting her during episodes. Remote or solitary assignments are contraindicated in pregnant patients with seizure disorders.

b. Nerve Root Disorders

A variety of nerve root[109] and peripheral nerve disorders may occur during pregnancy. The characteristic symptoms of nerve root disorders include pain, sensory deficits, decreased tendon reflexes, or weakness in a segmental distribution. Peripheral nerve disease usually presents first with dysesthesia and later with sensory and motor deficits in the distribution of the involved nerve. In the legs, the pain is usually unilateral, follows the distribution of the sciatic nerve, and may be accompanied by low back pain. There is usually little if any subjective weakness. Activities such as coughing, sneezing, bearing down, lifting, and low back motion increase the symptoms. When this occurs, the pregnant worker should limit weight bearing or lifting; orthopedic consultation will assist in selection of proper exercise and bracing.

c. Peripheral Nerve Disease

The most common peripheral nerve disease is brachial neuralgia, occuring in approximately 5% of pregnancies.[110] Onset may be sudden or gradual, and symptoms may be intermittent. The pain is usually in the shoulders and upper arms and may be exaggerated by head or shoulder movement. It may be more frequent in some positions of the head, neck, or shoulders. It is usually most marked in the evening. It tends to be exacerbated with lifting or with the arms in the dependent positions for long periods. Most of the symptoms respond to rest, use of a cervical collar, and postural care during the day and night. In addition, exercise may strengthen the affected muscles, and analgesics may be useful.

Carpal tunnel syndrome is also sometimes noted during pregnancy, and may be of some importance if the pregnant worker's safety depends on manual dexterity.

3. Environmental Factors

a. Vibration

The term "vibration" as used here refers to frequencies of less than 20 cycles/sec (Hz) over the whole body, sometimes called "infrasound." Localized vibrations may be produced by hand tools in frequencies of 30-150 Hz. The effects of whole body or localized vibration on the pregnant woman or fetus are not known. Physicians caring for pregnant women who are exposed to such factors should consider each case individually and make a clinical judgment whether tolerance may be decreased by abnormalities in the woman and/or fetus.[111]

b. Noise

Effects of noise on pregnancy are not known. Sound transmits to the fetus but no harmful effects have been documented.

c. Ultrasound

Extensive experience with ultrasound mapping of the fetal position has not been associated with any demonstrable ill effects to the pregnant woman or fetus. Because ultrasound transmits poorly through air, and job exposures rarely involve direct body contact with the generator, ultrasound exposure is probably not of concern.

VII. APPENDICES

A. References

1. Hunt, V., The Health of Women at Work (Evanston, Illinois: Northwestern University Program on Women, 1977), p. 3.

   Hricko, A., Working for Your Life, Labor Occupational Health Program and Public Citizen's Health Research Group, 1976, p. iii.

   U.S. Department of Labor, Bureau of Labor Statistics, Bulletin #1905 "Handbook of Labor Statistics, 1976."

2. U.S. Department of Labor, Occupational Health and Safety Administration, General Industry Safety and Health Standards, OSHA Report No. 2206, June 1974.

   U.S. Department of Health, Education and Welfare, National Institute for Occupational Safety and Health, Annual List of Toxic Substances.

3. Grosch, D., "Effects of Toxicants on Reproductive Performance," Essays in Toxicology, 7:2-28, 1976.

4. Cimons, M., "Occupational Health vs. Civil Rights for Women," The New Republic, May 21, 1977.

5. Cantarow, A., and Trumper M., Lead Poisoning (Baltimore: Williams and Wilkins, 1944).

6. U.S. Department of Health, Education and Welfare, National Institute for Occupational Safety and Health, "Occupational Exposure to Waste Anesthetic Gases and Vapors," NIOSH Report #77-140, March 1970.

7. Knill-Jones, R., Newman, B., Spence, A., "Anesthetic Practice and Pregnancy--Controlled Survey of Male Anesthetists in the United Kingdom," Lancet, 2:07-09, 1975.

8. An example is the system developed with The American College of Obstetricians and Gynecologists, distributed by Hollister Incorporated, 211 East Chicago Avenue, Chicago, Illinois 60611.

9. See Glossary.

10. See Interprofessional Relations.

11. See Appendix.

12. "Food, Pregnancy, and Family Health," The American College of Obstetricians and Gynecologists, Publication No. R-37, 1976.

13. Ericksson, M., et al., "Drugs and Pregnancy," Clin. Obstet. Gynecol., 16:199, 1973.

14. Adapted from Messite, J., and Bond, M., "Women and Work," in Zenz, C., ed., Occupational Medicine: Principles and Practical Applications, 2nd edition (in preparation).

15. Haynes, D., "Course and Conduct of Normal Pregnancy," in Danforth, D., Obstetrics and Gynecology, third edition (Hagerstown: Harper and Row, 1977), p. 299.

16. Pritchard, J., and MacDonald, P., Williams Obstetrics, fifteenth edition (New York: Appleton-Century-Crofts, 1976), p. 212.

17. Haynes, D., op. cit., p. 299.

18. Hale, R., "Diagnosis of Pregnancy and Associated Conditions," in Benson, R., Current Obstetric and Gynecologic Diagnosis and Treatment (Los Altos, California: Lange Medical Publishers, 1976), p. 480-1.

19. Quilligan, E., "General and Systemic Changes," in Danforth, D., op. cit., p. 276.

20. Hytten, F., and Leitch, I., The Physiology of Human Pregnancy (Oxford: Blackwell Press, 1964), p. 114.

21. Quilligan, E., op. cit., p. 278.

22. Haynes, D., op. cit., p. 300.

23. Haynes, D., op. cit., p. 299.

24. Pritchard, J. and MacDonald, P., op. cit., p. 616.

25. Ibid.

26. Niswander, K., "Prenatal Care," in Benson, R., op. cit., p. 538.

27. Levy, N., Lemberg, E., and Sharf, M., "Bowel Habit in Pregnancy," Digestion 4:216, 1971.

28. Hellman, L., and Pritchard, J., Williams Obstetrics, fourteenth edition (New York: Appleton-Century-Crofts, 1971), p. 264-65.

29. Ueland, K., et al., "Maternal Cardiovascular Dynamics: The Influence of Gestational Age on Maternal Cardiovascular Response to Posture and Exercise," Am. J. Obstet. Gynecol., 104:856, 1969.

30. Niswander, K., op. cit.

31. Pritchard, J. and MacDonald, P., op. cit., p. 616.

32. Easterling, W., in Danforth, D., op. cit., p. 710.

33. Easterling, W., in Danforth, D., op. cit., p. 709.

34. Brazie, J., and Lubchenco, L., "The Newborn Infant," in Benson, R., op. cit., p. 676.

35. Kennel, J., et al., "Evidence for a Sensitive Period in the Human Mother," CIBA Foundation Symposium, 33:187, 1975.

Klaus, M., et al., "Maternal Attachment: Importance of the First Postpartum Days," NEJM, 286:460, 1972.

36. Babson, G., et al., Management of High Risk Pregnancy and Intensive Care of the Neonate (St. Louis: C. V. Mosby, 1975), p. 14.

Schneider, J., "Low Birth Weight Infants," Obstetrics and Gynecology, 31:283, 1968.

37. Pernoll, M., "Prenatal Diagnosis: Practice, Pitfalls, and Progress," Obstetrics and Gynecology, 44:773, 1974.

Schneider, J., "Repeated Pregnancy Loss," Clin. Obstet. Gynecol., 16:120, 1973.

38. Standards for Obstetric-Gynecologic Services, The American College of Obstetricians and Gynecologists, Chicago, 1974, p. 37.

39. Eastman, N., and Jackson, E., "Weight Relationships in Pregnancy," Obstetric-Gynecologic Survey, 23:1003, 1968.

40. Babson, G., op. cit., p. 6-12.

41. Rush, D., "Examination of the Relationship between Birthweight, Cigarette Smoking During Pregnancy, and Maternal Weight Gain," J. Obstet. Gynecol. Br. Commonw., 81:746, 1974.

42. Mulvihill, J. and Yeager, A., "Fetal Alcohol Syndrome," Obstetric Gynecologic Survey, 32:151-153, 1977.

43. Kaiser, I., "Fertilization and Physiology and Development of Fetus and Placenta," in Danforth, D., op. cit., p. 253-5.

44. James, L., "The Newborn Infant," in Danforth, D., op. cit., p. 764.

Chesley, L., "Cardiovascular Changes in Pregnancy," in Wynn, R., ed., Obstetrics and Gynecology Annual (New York: Appleton-Century-Crofts, 1975), p. 87-93.

45. Pernoll, M., "High Risk Pregnancy," in Benson, R., op. cit., p. 515-6.

46. Green, J., "Diabetes Mellitus in Pregnancy," Obstet. Gynecol., 46:724, 1975.

47. Ho, S., and Wu, P., "Perinatal Factors and Neo-natal Morbidity in Twin Pregnancy," Am. J. Obstet. Gynecol., 123:67, 1975.

48. "Guidelines for Diagnostic X-Ray Examination of Fertile Women," The American College of Obstetricians and Gynecologists, Chicago, Illinois, 1977.

"Review of NCRP Radiation Dose Limit for Embryo and Fetus in Occupationally Exposed Women," National Council on Radiation Protection and Measurements, Report No. 53, Washington, 1977.

49. Monif, G., Infectious Diseases in Obstetrics and Gynecology (Hagerstown: Harper and Row, 1974).

50. Ibid.

51. NIOSH Report No. 77-140, op. cit.

52. Ulmer, D., "Trace Elements," NEJM, 297(6):318-321, Aug. 11. 1977.

53. Oliver, T., "Lead Poisoning and the Race," Brit. Med. J., p. 1096, May 13, 1911.

54. Ganyaire: These de Paris, 1900, in Holt, L., "Lead Poisoning in Infancy," Am. J. Dis. Child., 25:229-233, 1923.

55. Oliver, T., op. cit.

Lancranjan, I., et al., "Reproductive Ability of Workmen Occupationally Exposed to Lead," Arch. Environ. Health, 30:396-401, August 1975.

56. Ferm, V., "The Teratogenic Effects of Metals on Mammalian Embryos," Advances in Teratology, 5:51, 1972.

57. Zollinger, H., "Kidney Adenomas and Carcinomas in Rats Caused by Chronic Lead Poisoning and Their Relationship to Corresponding Human Neoplasms," Virchow Arch. Pathol. Anat., 323:694-710, 1953.

58. Matsumoto, H., et al., "Fetal Minimata Disease," J. Neuro. Path. Exp. Neurol., 24:563-74, 1965.

59. Hunt, V., Occupational Health Problems of Pregnant Women, U.S. Department of Health, Education and Welfare, No. SA-5304-75, 1975, p. 59.

60. Bellanti, J., "Immunologic Response to Chemical Pollutants," Pediatrics, 53:818, Part 2, May 1974.

61. Hardy, H., "Beryllium Poisoning--Lessons in Control of Man-Made Disease," NEJM, 273:1188, 1965.

62. Finklea, J., et al., "Polychlorinated Biphenyls Residues in Human Plasma Expose a Major Urban Pollution Problem," Am. J. Pub. Health, 62(5):645, May 1972.

63. Whalen, R., Remarks delivered before the Subcommittee on Health and Scientific Research, Committee on Human Resources, U.S. Senate, June 8, 1977.

64. Infante, P., et al., "Genetic Risks of Vinyl Chloride," Lancet, 1:734, 1976.

Ducatman, A., et al., "Vinyl Chloride and Human Chromosomal Aberration," Mutational Resch., 31:163, 1975.

65. U.S. Department of Health, Education and Welfare, National Institute for Occupational Safety and Health, "Occupational Exposure to Carbon Disulfide," Report No. 77-136, May 1977.

66. "The Susceptibility of the Fetus and Child to Chemical Pollutants," Pediatrics, 53(5):1974.

67. Smithels, R., "Defects and Disabilities of Thalidomide Children," Brit. Med. J., 1:269-272, 1973.

68. Mulvihill, J. and Yeager, A., op. cit.

69. Briebart, S., Bongiovanni, A., and Everlein, W., "Progestins and Skeletal Maturation," NEJM, 268:265, 1963.

70. Hanson, J., Myrianthropoulos, N., Harvey, M., and Smith, D., "Risks to the Offspring of Women Treated with Hydantoin Anticonvulsants, with Emphasis on the Fetal Hydantoin Syndrome," J. Ped., 89:662-668, 1976.

71. Warkany, J., "Congenital Malformations," Notes and Comments, 1971 (Chicago: Year Book Medical Publishers, Inc.), p. 96.

72. Goldfield, N. and Weinstein, M., "Lithium Carbonate in Obstetrics: Guidelines for Clinical Use," Am. J. Obstet. Gynecol., 116:15-22, 1973.

73. Belafsky, H., Breslow, S., Hirsch, L., Shangold, J. and Stahl, M., "Meprobamate During Pregnancy," Obstet. Gynecol., 34:378-386, 1969.

74. Nora, J., McNamara, D., and Frazer, F., "Dextroamphetamine Sulfate and Human Malformations," Lancet, 1:570-571, 1967.

75. Becker, J., Genieser, N., Finegold, M., Miranda, D. and Spackman, T., "Chondrodysplasia Punctata: Is Maternal Warfarin Therapy a Factor?," Am. J. Dis. Child., 129(3):356-359, 1975.

76. Herbst, A., Kurman, R. and Scully, R., "Vaginal and Cervical Abnormalities After Exposure to Stilbestrol in Utero," Obstet. Gynecol., 40:287-298, 1972.

77. Collins, E. and Turner, G., "Maternal Effects of Regular Salicylates Ingestion in Pregnancy," Lancet, 2(7930):335-36, 1975.

78. Corby, D. and Schulman, I., "The Effects of Antenatal Drugs Administration on Aggregation of Platelets of Newborn Infants," J. Ped., 79:307-313, 1971.

79. The American College of Obstetricians and Gynecologists, Precis: An Update in Obstetrics and Gynecology (McGraw-Hill, 1977), p. 21.

80. Catz, C. and Abuelo, D., "Drugs and Pregnancy," Drug Therapy, 1:79-91, 1974.

81. Yaffe, S. and Catz, C., "Drugs and the Intrauterine Patient," in Risks in the Practice of Modern Obstetrics (St. Louis: C. V. Mosby Company, Aladjem, S., editor, 1972), pp. 82-103.

82. American Academy of Pediatrics, Committee on Environmental Hazards, "Effects of Cigarette Smoking on the Fetus and Child," Ped., 57:411-413, 1976.

83. Quilligan, E., op. cit., p. 276.

84. Ibid., p. 274-5.

85. Ibid., p. 276.

86. Kahler, R., "Cardiac Disease," in Burrow, G., and Ferris, T., Medical Complications During Pregnancy (Philadelphia: Saunders, 1975), p. 110.

87. Ibid., p. 121.

88. Lubs, H., and Lubs, M., "Genetic Disorders," in Burrow and Ferris, op. cit., p. 821.

89. Kahler, op. cit., p. 127-9.

90. Ibid.

91. Levin, J. and Algazy, K., "Hematologic Disorders," in Burrow and Ferris, op. cit., p. 699.

92. Horvath, S. and Jensen, R., eds., "Standards for Occcupational Exposure to Hot Environments," U.S. Department of Health, Education and Welfare, National Institute for Occupational Safety and Health, Report No. 76-100, January 1976.

93. Cameron, R., "Should Air Hostesses Continue Flight Duty During the First Trimester of Pregnancy?" Aerosp. Med., 44(5):552, May 1973.

94. Warshaw, L., The Heart in Industry (New York: Hoeber Publishers, 1960), p. 499ff.

Brown, A., "The Susceptibility of the Fetus and Child to Chemical Pollutants," Ped., 53(5):816-7, May 1974.

95. Quilligan, E., op. cit., p. 272.

96. Pritchard, J., and MacDonald, P., op. cit., p. 189.

97. Hytten, F., and Leitch, I., op. cit., p. 118.

98. Ganong, W., Review of Medical Physiology (Los Altos: Lange Medical Publications, 1973), Chapter 34.

99. Sulavik, S., "Pulmonary Disease," in Burrow and Ferris, op. cit., p. 549.

100. Ibid., p. 563ff.

101. Pritchard, J., and MacDonald, P., op. cit., p. 616.

102. Pritchard, J., and MacDonald, P., op. cit., p. 199.

103. Buttrey, S., "Validation of 'Ergonomics/Physical Energy Conditions'," Department of Industrial and Operations Engineering, University of Michigan, August 1977.

104. Bader, R., Rose, D., Braunwald, E., "Hemodynamics at Rest and During Exercise in Normal Pregnancy," J. Clin. Inves., 34(10):1524-36, 1955.

Diddle, A., "Gravid Women at Work," J. Occup. Med., 12(1):10-15, 1970.

Emerson, K., Saxena, B., Poindexter, E., "Caloric Cost of Normal Pregnancy," Obstet. Gynec., 40(6):786-794, 1972.

105. Garg, A., "A Metabolic Rate Prediction Model for Manual Material Handling Jobs," Department of Industrial and Operations Engineering, University of Michigan, 1976.

Seitchik, J., "Body Composition and Energy Expenditure During Rest and Work in Pregnancy," Am. J. Obst. Gynec., 97(5):701-13, 1967.

106. Kane, R., Erez, S., O'Leary, J., "Symptomatic Symphyseal Separation in Pregnancy," Surg. Gyn. Obstet., 124(5):1032-6, 1967.

107. Chaffin, D., "Biomechanics of Manual Materials Handling and Low-Back Pain," in Zenz, C., ed., Occupational Medicine: Principles and Practical Applications, first edition (Year Book Medical Publishers, 1975).

108. Dalessio, D., "Neurologic Complications," in Burrow and Ferris, op. cit., p. 657-661.

109. Ibid., p. 684.

110. Ibid., op. cit., p. 680.

111. Gratsianskaya, L., Eroshenko, E., Libertovich, A., "Influence of High Frequency Vibration on the Genital Region in Females," Gig. Tr. Prof. Zabol., 18(8):7-10, 1974.

112. An incomplete list. Additional resources will include state, county, and local medical societies; colleges and universities; poison control centers; individual practitioners in obstetrics and occupational health; trade associations and unions for the specific industries in question.

113. Hunt, V., Occupational Health Problems, op. cit.

114. Taylor, A., personal communication, 1977.

B. Suggested Readings

The following readings have been selected from the comprehensive bibliography on pregnancy and work prepared in conjunction with this project. This complete bibliography was filed with the National Institute for Occupational Safety ahd Health.

1. Books

a. American College of Obstetricians and Gynecologists, Precis: An Update in Obstetrics and Gynecology, McGraw-Hill, 1977.

b. American College of Obstetricians and Gynecologists, "Standards for Obstetric-Gynecologic Services," 1974.

c. Babson, G., et. al., Management of High Risk Pregnancy and Intensive Care of the Neonate, C. V. Mosby, St. Louis, 1975.

d. Benson, R., Current Obstetric and Gynecologic Diagnosis and Treatment, Lang Medical Publications, Los Altos, California, 1976.

e. Bingham, E., (ed.) Proceedings of the Conference on Women and the Workplace, Society for Occupational and Environmental Health, Washington, D. C., 1977.

f. Browning, E., Toxicity and Metabolism of Industrial Solvents, Elsevier Publ. Co., Amsterdam, 1965.

g. Burrow, G. and Ferris, T., Medical Complications During Pregnancy, Philadelphia, Saunders, 1975.

h. Danforth, D., Obstetrics and Gynecology, Third Edition, Harper and Row, Hagerstown, Maryland, 1977.

i. Hricko, A., Working for Your Life, Labor Occupational Health Proaram and Public Citizen's Health Research Group, 1976.

j. Hunt, V., Occupational Health Problems of Pregnant Women, DHEW Order No. SA-5304-75, 1975.

k. Hunter, D., The Diseases of Occupations, English Universities Press, London, 1955.

l. Pritchard, J. and McDonald, P., Williams Obstetrics, Fifteenth Edition, Appleton Century-Crofts, New York, 1976.

m. Zenz, C. (ed.), Occupational Medicine: Principles and Practical Applications, First Edition, Year Book Medical Publishers, 1975.

2. Articles and Other Readings

a. "Guidelines for Diagnostic X-Ray Examination of Fertile Women," American College of Obstetricians and Gynecologists, Chicago, IL, 1977.

b. "Food, Pregnancy, and Family Health," American College of Obstetricians and Gynecologists, Publication No. R-37, 1976.

c. Bader, R., Rose, D., Braunwald, E., "Hemodynamics at Rest and during Exercise in Normal Pregnancy," J. Clin. Inves., 34(10): 1524-36, October 1955.

d. Bellanti, J., "Immunologic Response to Chemical Pollutants," Pediatrics, 53:818, Part 2, May 1974.

e. Brown, A., "The Susceptibility of the Fetus and Child to Chemical Pollutants," Pediatrics 53(5): 816-7, May 1974.

f. Catz, C. and Abuelo, D., "Drugs and Pregnancy," Drug Therapy, 1:79-91, 1974.

g. Ericksson, M., et. al., "Drugs and Pregnancy," Clin. Obstet. Gynecol., 16:199, 1973.

h. "Review of NCRP Radiation Dose Limit for Embryo and Fetus in Occupationally Exposed Women," National Council on Radiation Protection and Measurements, Report #53, Washington, D. C., 1977.

i. Pernoll, M., "Prenatal Diagnosis: Practice, Pitfalls, and Progress," Obstetrics and Gynecology, 44: 773, 1974.

j. Seitchik, J., "Body Composition and Energy Expenditure during Rest and Work in Pregnancy," Am. J. Obst. Gynec., 97 (5): 701-13, March 1967.

k. "The Susceptibility of the Fetus and Child to Chemical Pollutants," Pediatrics, 53(5): 1974.

l. Ulmer, D., "Trace Elements," NEJM 297(6): 318-321, August 11, 1977.

C. Resources and Contacts [112]

1. National Institute for Occupational Safety and Health

a. National Headquarters

Parklawn Building
5600 Fishers Lane
Rockville, Maryland 20857

b. Cincinnati Office

Robert A. Taft Laboratories
4676 Columbia Parkway
Cincinnati, Ohio 45226

c. Appalachian Center

Appalachian Center for Occupational Safety and Health (ACOSH)
944 Chestnut Ridge Road
Morgantown, West Virginia 16505

d. Region I: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

(Vacancy)
Regional Consultant, NIOSH
DHEW, Region I
Government Center (JFK Fed. Bldg.)
Boston, Massachusetts 02203
Tel: 617/223-6668

Region II: New Jersey, New York, Puerto Rico, Virgin Islands

Mary L. Brown, R.N.
Regional Consultant, NIOSH
DHEW, Region II - Fed. Building
26 Federal Plaza
New York, New York 10007
Tel: 212/264-2485

Region III: Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, West Virginia

William E. Shoemaker
Regional Consultant, NIOSH
DHEW, Region III
P. O. Box 13716
Philadelphia, Pennsylvania 19101
Tel: 215/596-6716

Region IV: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee

Paul Roper
Regional Consultant, NIOSH
DHEW, Region IV
50 Seventh Street, N.E.
Atlanta, Georgia 30323
Tel: 404/881-4474
FTS: 257-4474

Region V: Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin

Richard Kramkowski
Regional Consultant, NIOSH
DHEW, Region V
300 South Wacker Drive
Chicago, Illinois 60607
Tel: 312/886-3881

Region VI: Arkansas, Louisiana, New Mexico, Oklahoma, Texas

George L. Pettigrew
Regional Consultant, NIOSH
DHEW, Region VI
1200 Main Tower Bldg., Rm. 1700-A
Dallas, Texas 75202
Tel: 214/655-3081
FTS: 729-3081

Region VII: Iowa, Kansas, Missouri, Nebraska

Ralph J. Bicknell
Regional Consultant, NIOSH
DHEW, Region VII
601 East 12th Street
Kansas City, Missouri 64106
Tel: 816/374-5332
FTS: 758-5332

Region VIII: Colorado, Montana, Utah, Wyoming, North Dakota, South Dakota

Stanley J. Reno
Regional Consultant, NIOSH
DHEW/PHS/Prevention - Region VIII
11037 Federal Building
Denver, Colorado 82094
Tel: 303/837-3979
FTS: 327-3979

Region IX: Arizona, California, Hawaii, Nevada

Douglas L. Johnson
Regional Consultant, NIOSH
DHEW, Region IX
50 United Nations Plaza - Rm. 231
San Francisco, California 94102
Tel: 415/556-3781

Region X: Alaska, Idaho, Oregon, Washington

Walter E. Ruch, Ph.D.
Regional Consultant, NIOSH
DHEW, Region X
1321 Second Avenue (Arcade Bldg.)
Seattle, Washington 98101
Tel: 206/442-0530
FTS: 399-0530

2. Occupational Safety and Health Administration

a. Headquarters

Occupational Safety and Health Administration
U. S. Department of Labor
200 Constitution Avenue, N.W.
Washington, D. C. 20210

b. Region I: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

Gilbert J. Saulter, Regional Administrator
U. S. Department of Labor - OSHA
JFK Federal Building
Room 1804 - Government Center
Boston, Massachusetts 02203
Tel: 617/223-6712/3
FTS: 223-6712/3

Region II: New Jersey, New York, Puerto Rico, Virgin Islands, Canal Zone

Alfred Barden, Regional Administrator
U. S. Department of Labor - OSHA
1515 Broadway (1 Astor Plaza) - Room 3445
New York, New York 10036
Tel: 212/399-5941
FTS: 622-5941

Region III: Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, West Virginia

David H. Rhone, Regional Administrator
U. S. Department of Labor - OSHA
Gateway Building - Suite 2100
3535 Market Street
Philadelphia, Pennsylvania 19104
Tel: 215/596-1201
FTS: 596-1201

Region IV: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, Tennessee

Donald E. Mackenzie, Regional Administrator
U. S. Department of Labor - OSHA
1375 Peachtree Street, N. E. - Suite 587
Atlanta, Georgia 30309
Tel: 404/881-3575
FTS: 257-2281/3573

Region V: Illinois, Indiana, Minnesota, Ohio, Wisconsin

Barry J. White, Regional Administrator
U. S. Department of Labor - OSHA
32nd Floor - Room 3263
230 South Dearborn Street
Chicago, Illinois 60604
Tel: 312/353-2220
FTS: 353-2220

Region VI: Arkansas, Louisiana, New Mexico, Oklahoma, Texas

Robert Tice, Regional Administrator
U. S. Department of Labor - OSHA
555 Griffin Square Bldg. - Room 602
Dallas, Texas 75202
Tel: 214/749-2477
FTS: 749-2477

Region VII: Iowa, Kansas, Missouri, Nebraska

Vernon A. Strahm, Regional Administrator
U. S. Department of Labor - OSHA
911 Walnut Street - Room 3000
Kansas City, Missouri 64106
Tel: 816/374-5861
FTS: 758-5861

Region VIII: Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming

Curtis Foster, Regional Administrator
U. S. Department of Labor - OSHA
Federal Building - Room 15010
1961 Stout Street
Denver, Colorado 80202
Tel: 303/837-3883
FTS: 327-3883

Region IX: California, Arizona, Nevada, Hawaii, American Samoa, Guam, Trust Territory of the Pacific Islands

Gabriel Gillotti, Regional Administrator
U. S. Department of Labor - OSHA
9470 Federal Building
450 Golden Gate Avenue - P. O. Box 36017
San Francisco, California 94102
Tel: 415/556-0586
FTS: 556-0586

Region X: Alaska, Idaho, Oregon, Washington

James W. Lake, Regional Administrator
U. S. Department of Labor - OSHA
Federal Office Bldg., Room 6048
909 First Avenue
Seattle, Washington 98174
Tel: 206/442-5930
FTS: 399-5930

3. State Designated Agencies

Alabama

Howard E. Hendrix, Commissioner
Alabama Department of Labor
600 Administrative Building
64 North Union Street
Montgomery, Alabama 36130
Tel: 205/832-6270
FTS: 534-7297

Alaska

Edmund N. Orbeck, Commissioner
Department of Labor
P. O. Box 1149
Juneau, Alaska 99811
Tel: 907/465-2700

Arizona

Harry G. Kelley, Director
Industrial Commission on Arizona
1601 W. Adams
P. O. Box 19070
Phoenix, Arizona 85005
Tel: 602/271-4411
FTS: 765-4411

Arkansas

Charles Daniels, Commissioner
Department of Labor
Capitol Hill Building
Little Rock, Arkansas 72201
Tel: 501/371-1401

California

Leonard M. Grimes, Secretary
Steven Jablonsky, CAL/OSHA Program Manager
Agriculture and Services Agency
1220 N Street, Room 409
Sacramento, California 95814
Tel: 916/445-1935

Colorado

Ms. Juereta P. Smith, Director
Colorado Division of Labor
Department of Labor and Employment
1313 Sherman Street
Denver, Colorado 80203
Tel: 303/892-3596

Connecticut

Frank Santaguida, Commissioner
Connecticut Department of Labor
200 Folly Brook Boulevard
Wethersfield, Connecticut 06109
Tel: 203/566-4384
FTS: 641-4384

Delaware

Donald T. Whiteley, Secretary
Department of Labor
801 West Street
Wilmington, Delaware 19801
Tel: 302/571-2710

District of Columbia

Charles T. Greene,CSP, Director
Minimum Wage & Industrial Safety Board
Industrial Safety Division
Government of the District of Columbia
2900 Newton Street, N.E.
Washington, D. C. 20018
Tel: 202/832-1230

Florida

Edward J. Tombetta, Secretary
Department of Commerce
Division of Labor
510 Collins Building
Tallahassee, Florida 32304
Tel: 904/488-3104

Georgia

Sam Caldwell, Commissioner
Department of Labor
288 State Labor Building
Atlanta, Georgia 30334
Tel: 404/656-3011

Guam

J.S.M. Paloma, Director
Juam Limtiaco, Director
Division of Occupational Safety
Department of Labor
Government of Guam
P. O. Box 884 (JSMP)
Agana, Guam 96910
Tel: 777-9822

Hawaii

Joshua Agsaud, Director
Department of Labor Industrial Relations
825 Mililani Street
Honolulu, Hawaii 96813
Tel: 808/548-3151

Idaho

Bartlett Brown, Commissioner
Department of Labor
317 Main Street
Room 300
Boise, Idaho 83702
Tel: 208/964-2327
FTS: 554-2327

Illinois

Donald A. Johnson, Director
Illinois Department of Labor
160 North La Salle Street
Chicago, Illinois 60601
Tel: 312/793-2800

Indiana

William Lanam, Commissioner
Indiana Division of Labor
Indiana State Office Bldg.
100 North Senate Avenue
Indianapolis, Indiana 46204
Tel: 317/633-4473
FTS: 336-4473

Iowa

Walter Johnson
Acting Commissioner
Bureau of Labor, State House
East 7th & Court Avenue
Des Moines, Iowa 50319
Tel: 515/281-3606
FTS: 863-3606

Kansas

Dr. James A. McCain, Secretary
Department of Human Resources
401 Topeka Avenue
Topeka, Kansas 66603
Tel: 913/296-7474
FTS: 757-7474

Kentucky

James R. Yocom, Commissioner
Kentucky Department of Labor
Capitol Plaza
Frankfort, Kentucky 40601
Tel: 502/564-3070

Louisiana

Curtis C. Luttrell, Commissioner
Louisiana Department of Labor
Post Office Box 44063
Baton Rouge, Louisiana 70804
Tel: 504/389-5314

Maine

Emilien Levesque, Commissioner
Department of Manpower Affairs
State House
Augusta, Maine 04330
Tel: 207/289-3814

Maryland

Harvey A. Epstein, Commissioner
John W. Parrott, Deputy Commissioner
Division of Labor & Industry
Department of Licensing and Regulation
203 E. Baltimore Street
Baltimore, Maryland 21202
Tel: 301/383-2250
FTS: 932-2250

Massachusetts

Nicholas Roussos, Commissioner
Massachusetts Department of Labor and Industries
Leverett Saltonstall Building
Government Center - 11th Floor
Boston, Massachusetts 02202
Tel: 617/727-3454

Michigan

Keith E. Molin, Director
Michigan Department of Labor
309 N. Washington
Lansing, Michigan 48909
Tel: 517/373-9600
FTS: 253-9600

Minnesota

E. I. (Bud) Malone, Commissioner
State of Labor & Industry
Space Center Building - 5th Floor
444 Lafayette Road
St. Paul, Minnesota 55101
Tel: 612/296-2342
FTS: 776-2342

Mississippi

Alton B. Cobb, M.D., State Health Officer
Mississippi State Board of Health
Post Office Box 1700
Jackson, Mississippi 39205
Tel: 601/354-6646

Missouri

Geoffrey McCarron, Commissioner
Department of Labor and Industrial Relations
Box 599
Jefferson City, Missouri 65101
Tel: 314/751-2461

Montana

Norman Grosfield, Administrator
Division of Workers' Compensation
815 Front Street
Helena, Montana 59601
Tel: 406/449-2047
FTS: 587-2047

Nebraska

Gerald L. Chizek, Commissioner
Department of Labor
P. O. Box 94600
State House Station
Lincoln, Nebraska 68509
Tel: 402/475-8451

Nevada

Ralph Langley, Director
Department of Occupational Safety and Health
Nevada Industrial Commission
515 E. Musser Street
Carson City, Nevada 89701
Tel: 702/885-5241

New Hampshire

Robert M. Duvall, Commissioner
Richard Reiff, Chief Safety Inspector
State of New Hampshire
Department of Labor
(Occupational Safety)
1 Pillsbury Street
Concord, New Hampshire 03301
Tel: 603/225-6611

New Jersey

Joseph Hoffman, Commissioner
Department of Labor & Industry
John Fitch Plaza
Trenton, New Jersey 08625
Tel: 609/292-2323

New Mexico

Fernando C. deBaca, Executive Director
Health and Social Services Department
P. O. Box 2348
Santa Fe, New Mexico 87501
Tel: 505/827-2371
FTS: 476-2371

New York

Honorable Philip Ross
Commissioner of Labor
State of New York
Two World Trade Center
New York, New York 10047

North Carolina

John D. Brook, Commissioner
North Carolina Department of Labor
P. O. Box 27407
Raleigh, North Carolina 27611
Tel: 919/829-7166

North Dakota

Bronald Thompson, Chairman
Workmen's Compensation Bureau
Russell Building
Highway 83 North
Bismarck, North Dakota 58505
Tel: 701/224-2700

Ohio

Phillip Paul, Chief
Division of Occupational Safety and Health
Department of Industrial Relations
2323 West Fifth Avenue, Room 2380
Columbus, Ohio 43216
Tel: 614/466-4124
FTs: 942-4124

Oklahoma

William E. Foster, Commissioner
Oklahoma State Department of Labor
State Capitol Building
Oklahoma City, Oklahoma 73105
Tel: 405/521-2461

Oregon

Keith Wilson, Board Chairman
Workmens' Compensation Board
Labor and Industries Building
Salem, Oregon 97310
Tel: 503/378-3311
FTS: 530-3311

Pennsylvania

Paul J. Smith, Secretary
Department of Labor & Industry
1700 Labor & Industry Building
Harrisburg, Pennsylvania 17120
Tel: 717/787-3157

Puerto Rico

Secretary of Labor, Carlos Quiros
Assistant Secretary OSH, John Cinque
Department of Labor
Commonwealth of Puerto Rico
414 Barbosa Avenue
San Juan, Puerto Rico 00917
Tel: 809/765-3030

Rhode Island

Salvatore T. DiSano, Director
Rhode Island Department of Labor
235 Promenade Street
Providence, Rhode Island 20908
Tel: 401/277-2741

South Carolina

E. L. McGowan, Commissioner
Department of Labor
3600 Forest Dirve
Post Office Box 11329
Columbia, South Carolina 29211
Tel: 803/758-2851

South Dakota

Judith K. Call, Secretary of Health
South Dakota Department of Health
Joe Foss Building
Pierre, South Dakota 57501
Tel: 605/224-3361

Tennessee

James Neeley, Commissioner
Tennessee Department of Labor
501 Union Building
Nashville, Tennessee 37219
Tel: 615/741-2582

Texas

David M. Cochran, Chief Bureau of Environmental Health
Texas Department of Health Resources
1100 West 49th Street
Austin Texas 78756
Tel: 512/458-7542

Utah

Carlyle F. Gronning, Chairman
Utah Industrial Commission
350 East Fifth South
Salt Lake City, Utah 84111
Tel: 801/533-6411

Vermont

Louis Lavin, Commissioner
Vermont Department of Labor and Industries
State Office Building
Montpelier, Vermont 05602
Tel: 802/223-2311
FTS: 832-2286

Virginia

Edmond M. Boggs, Commissioner
Robert F. Beard, Jr., Assistant Commissioner
Department of Labor & Industry
205 No. Fourth Street
Richmond, Virginia 23219
Tel: 804/786-2376
FTS: 936-2376

U. S. Virgin Islands

Honorable Richard Upson
Commissioner of Labor
Virgin Islands Department of Labor
Frederiksted, St. Croix
U. S. Virgin Islands 00840
Tel: 809/772-1315

Washington

John Hewitt, Director
Department of Labor and Industries
308 East Fourth Avenue
Olympia, Washington 98501
Tel: 206/753-6307

West Virginia

Steven L. Cook, Commissioner
State Department of Labor
State Office Building #6
1900 Washington Street, E.
Charleston, West Virginia 25305
Tel: 304/348-7890
885-7890

Wisconsin

Virginia Hart, Chairman
John Wenning, Administrator
Ron Remy, Chief, Compliance Section
Division of Safety and Buildings
Department of Labor, Industry and Human Relations
201 East Washington Avenue
Post Office Box 7946
Madison, Wisconsin 53707
Tel: 608/266-1816; 3151 (R.R.)
FTS: 366-1816

Wyoming

William W. Wilkins, Administrator
Donald O. Owsley, Assistant Administrator
Occupational Health and Safety Department
200 East Eighth Avenue
Cheyenne, Wyoming 82002
Tel: 307/777-7786
FTS: 328-9786

4. Schools of Medicine
(Institutions with both Obstetrics-Gynecology and Occupational Medicine programs or the equivalent)

a. University of Arizona College of Medicine
Arizona Health Sciences Center
Tucson, Arizona 85724
602/882-6300

b. University of California at Irvine
California College of Medicine
Irvine, California 92717
714/833-5838

c. University of Cincinnati College of Medicine
231 Bethesda Avenue
Cincinnati, Ohio 45267
513/872-5491

d. Harvard Medical School
25 Shattuck Street
Boston, Massachusetts 02115
617/732-1000

e. Johns Hopkins University School of Medicine
720 Rutland Avenue
Baltimore, Maryland 21205
301/955-5000

f. University of Illinois College of Medicine
1853 West Polk Street
Chicago, Illinois 60612
312/996-2450

g. University of Michigan Medical School
1335 Catherine Street
Ann Arbor, Michigan 48109
313/764-8173

h. University of Minnesota Medical School - Minneapolis
145 Owre Hall, 421 Delaware Street, S.E.
Minneapolis, Minnesota 55455
612/373-4570

i. New York University School of Medicine
New York, New York 10016
212/679-3200

j. University of North Carolina at Chapel Hill
School of Medicine
Chapel Hill, North Carolina 27514
919/966-4161

Schools of Medicine (continued)

k. University of Texas Health Science Center at Houston
Medical School
P.O. Box 20708
Houston, Texas 77025
713/792-2121

l. University of Utah College of Medicine
50 North Medical Drive
Salt Lake City, Utah 84132
801/581-7201

m. University of Washington
School of Medicine
Seattle, Washington 98195
206/543-1060

n. Yale University School of Medicine
333 Cedar Street
New Haven, Connecticut 06516
203/436-4771

5. Professional Associations

a. The American College of Obstetricians and Gynecologists
One East Wacker Drive
Chicago, Illinois 60601
312/222-1600

b. American Industrial Hygiene Association
66 South Miller Road
Akron, Ohio 44313
216/836-9537

c. American Occupational Medical Association
150 North Wacker Drive
Chicago, Illinois 60606
312/782-2166

D. Examples of Women's Occupational Exposures

The following tables include examples of occupations in which a high proportion of women are employed. Some of the occupations with a very large female workforce may also be considered among the most hazardous [113]:

	1970	1960	Increase
Sewers and stitchers	812,716	534,258	34%
Registered nurses	807,359	567,884	30%
Nursing aides, orderlies, etc.	609,022	485,383	20%
Assemblers	454,611	270,769	40%
Hairdressers and cosmetologists	424,873	267,050	37%
Checkers, examiners, inspectors (manufacturing)	327,530	215,066	34%
Packers and wrappers	314,067	262,935	16%

Some of the typical occupational exposures are listed below.[114] Note that not all the substances included are referred to in Guidelines on Pregnancy and Work. Specific information about the toxicity of any particular substance can be obtained from the resources listed in Appendix C.

Occupation	Exposures
1. Textile and Related Operatives	
a. Textile operatives	raw cotton dust, noise, synthetic fiber dusts, formaldehyde, heat, dyes, flame retardants, asbestos
b. Sewers and stitchers	cotton and synthetic fiber dusts, noise, formaldehyde, organic solvents, flame retardants, asbestos
c. Upholsterers	same as above
(Some specific chemicals encountered in the above occupations are: benzene, toluene, trichloroethylene, perchloroethylene, chloroprene, styrene, carbon disulfide.)	
2. Hospital/Health Personnel	
a. Registered nurses, aides, orderlies	anesthetic gases, ethylene oxide, X-ray radiation, alcohol, infectious diseases, puncture wounds
b. Dental hygienists	X-ray radiation, mercury, ultrasonic noise, anesthetic gases
c. Laboratory workers (clinical and research)	wide variety of toxic chemicals, including carcinogens, mutagens, and teratogens, X-ray radiation

3. Electronics assemblers	lead, tin, antimony, trichloroethylene, methylene chloride, epoxy resins, methyl ethyl ketone
4. Hairdressers and cosmetologists	hair spray resins (poly vinyl pyrrolidone), aerosol propellants (freons) halogenated hydrocarbons, hair dyes, solvents of nail polish, benzyl alcohol, ethyl alcohol, acetone
5. Cleaning Personnel	
a. Launderers	soaps, detergents, enzymes, heat, humidity, industrially-contaminated clothing
b. Dry cleaners	perchloroethylene, trichloroethylene, stoddard solvent (naptha), benzene, industrially-contaminated clothing
6. Photographic Processors	caustics, iron salts, mercuric chloride, bromides, iodides, pyrogallic acid and silver nitrate
7. Plastic fabricators	acrylonitrile, phenol-formaldehydes, urea-formaldehydes, hexamethylene-tetramine, acids, alkalies, peroxide, vinyl chloride, polystyrene, vinylidene chloride
8. Domestics	solvents, hydrocarbons, soaps, detergents, bleaches, alkalies
9. Transportation operatives	carbon monoxide, polynuclear aromatics, lead, and other combustion products of gasoline, vibration, physical stresses
10. Sign painters and letterers	lead oxide, lead chromate pigments, epichlorohydrin, titanium dioxide, trace metals, xylene, toluene
11. Clerical personnel	physical stresses, poor illumination, trichloroethylene, carbon tetrachloride and various other cleaners, asbestos in air conditioning
12. Opticians and lens grinders	coal tar pitch volatiles, iron oxide dust solvents, hydrocarbons

13. Printing operatives	ink mists, 2-nitropropane, methanol, carbon tetrachloride, methylene chloride, lead, noise, hydrocarbon solvents, trichloroethylene, toluene, benzene, trace metals

E. Glossary of Terms in Occupational Medicine

Individuals vary in their capacity to withstand job stresses, so it is necessary that job exposures be quantified in terms of intensity, duration, and frequency and related to the tolerances of the individual patient under assessment. Environmental exposures are usually expressed in the following terms:

1. Environmental Monitoring - A program for sampling of air contaminants or physical energies in the work area in order to establish the level of worker exposure to such agents. For air contaminants, analyses should be done in the worker's breathing area.

2. Personal Monitoring - A program for measuring an individual worker's exposure (e.g., using a diary or personal measurement equipment or film badge worn by the worker throughout the work day).

3. Peak Level - The maximum allowable level of an exposure over a brief stated period (usually 5 to 15 min) during any one eight-hour work shift.

4. Ceiling Level - The maximum allowable level of an exposure at any time in a work shift.

5. Time-weighted Average - An average over a given working period of a person's exposure levels as determined by sampling at given times during the period.

6. Threshold Limit Value - An exposure level in which most people can work consistently for eight hours a day or other specified duration in a 40-hour week with no harmful effects. (These levels, however, do not take potential pregnancy effects into account.) TLV's are usually expressed as time weighted average for an eight-hour work day and 40-hour work week.

7. Biologic Limit Value - Concentration of a chemical agent or metabolite in biological specimens (e.g., blood, urine, breath, hair) which correlate with the environmental threshold limit and which, if exceeded, indicate excessive absorption of an air contaminant.

8. NIOSH Proposed Standard (Criteria Document) - A publication prepared by NIOSH after a critical evaluation of medical, biologic, engineering, chemical, and trade information and data has been made for the purpose of establishing a permissible exposure limit for a substance or physical agent in the occupational environment. The document includes recommended environmental and medical control procedures and record keeping provisions.

9. OSHA Standard - A standard established by the Occupational Safety and Health Administration (OSHA), stating a permissible exposure limit and peak or ceiling value for a substance or physical agent which must not be exceeded. This standard is promulgated by OSHA after consideration of health and safety impact as well as technical feasibility and economic impact, and serves as the basis of the OSHA enforcement program. The standard also includes required environmental control, record keeping, and posting provisions.

In a few, medical control requirements are included as well.

10. Titles and Stereotypes - The name of the company, the industry of which it is a part, and the list of its exposures are helpful bits of information. However, job titles can be misleading. For example, a pregnant employee in the maintenance department of a chemical plant could be a clerical worker performing light office work or an engineer working with critical processing equipment under pressure, strain, and exposed to high levels of chemical exposure. A secretary in an office building may have no significant exposure to chemicals, while a secretary in an office in a lead factory can have considerable lead exposure from contamination of the office. Further, job titles frequently vary from one company to another.

A

Abortion
- spontaneous, 6, 10, 20, 21 23, 24, 26
- threatened, 20, 26
- recurrent, 20
Abruptio placentae, 19
Additive effects, 8
Airborne matter, 32, 33
Alcohol, 19, 26, 28
Allergy, 32
Altitude,
See Barometric pressure
Amniocentesis, 19, 21
See also Genetic diagnosis
Androgens, 26
Anemia, 22, 28, 30
Anesthetics, 6, 24, 28
Aneurysm, 29
Antibody, 25
Anticonvulsants, 36
See also Pharmaceuticals
Antihistamines, 32
See also Pharmaceuticals
Anxiety, 29
Arrhythmia, 29
Arsine, 31
Asphyxiants, 33
Assumptions, basic, 1
Asthma, 32

B

Back pain, 18, 33
Balance, 18, 33, 35
Barometric pressure, 31
Belts, 35
Benefits, employment, 2, 4
Benzene, 31
Benzine,
See Benzene
Benzol,
See Benzene
Berylliosis, 25, 31, 33
Biological agents, 23
Biological monitoring,
See Monitoring
Birth control pills, 26
Birth defects
- attribution of, 3, 6
- records, 10
Birth weight, 18, 19
Blood gases, 20
Blood pressure, 28
Blood volume in pregnancy, 17, 18, 29
Blows, 35
Breast
- changes in pregnancy, 17, 18
- postpartum, 18
See also Lactation

C

Cadmium, 25
Carbon Disulfide, 26
Carbon Monoxide, 30, 31
Carcinogenesis, 6, 26, 27
Cardiac output in pregnancy, 17, 18, 20, 28, 29
Cardiovascular Disease, 29, 30, 31
Cardiovascular System, 28
Carpal Tunnel Syndrome, 37
Cerebral Palsy, 25
Cervix, incompetent, 20
Cesarean Section, 22
Chairs, 35
Chemotherapeutic drugs, 27
Chlorambucil, 27
Chloramphenicol, 27
Chlordiazepoxide Hydrochloride, 27
Chromosomal Aberrations, 26
Climbing, 34, 35
See also Falls
Clomiphene, 28
Coccyx, 34
Combination effects
- of substances, 3
Commuting, 8
Complications
- as disability, 4
- and deconditioning, 8
- of pregnancy, 20
- recovery, 22
Condition, general physical, 19
Conditioning, physical, 8
Confidentiality, 1
Congenital defects, 6, 24
Congenital heart disease, 29
Consent, informed, 1, 10
Constipation, 17, 18
Consultants of project, viii
Contraceptives, 26
Convulsions, Neonatal, 24
Core panel, vii
Cotton dust, 31

Coumarin, 27
Cyclophosphamide, 27

D

Data base, 7
Deconditioning, physical 8
Demographics, i, 3
Dextroamphetamine, 27
Diabetes, 21
Diary, job exposures, 7
Diet,
See Nutrition
Disability, pregnancy-related, 4
Dizziness, 17, 30
Drugs, drug use
See Pharmaceuticals
Dust, 32
Dyspnea, 18
Dystocia, 19

E

Edema, peripheral, 18
Effort, physical, 7, 8, 21, 34, 35
Electrolytes, 20
Emotional bonding, 19
Employer
- assumption about, 2
- and protection of employee, 4, 10
- health facility, 14
Employment opportunity, iii, 3
Environmental monitoring,
See Monitoring
Epidemiologic studies, 6, 10
Episiotomy, 18
Epoxy, 32
Equilibrium,
See Balance
Ergonomics, 34, 35
Ergotamine, 27
Estrogens, 27
Exposures, job
See Job exposures

F

Falls, 33
Fatigue, 8, 17, 22, 30, 32, 34, 35
Fetal distress, 19
Fetal growth, 22, 26
Film badge, 23
Flour, 33
Fluid retention, 18
Freon, 24
Fumes, 33

G

Gases, 33
See also Anesthetics
Gastrointestinal tract
- in pregnancy, 17, 18
Genetic counseling, 19, 20
Genetic defects, 6
Genetic diagnosis, 19
Glomerular filtration rate, 17

H

Halogenated hydrocarbons, 24, 25
Haloperidol, 27
Headache, 17
Heat & Humidity, 18, 30
Hematologic Disease, 30
Hematoxins, 31
Hemoglobin, 20
Hemolysis, 31
Hemorrhoids, 18
Hepato-Renal toxicity, 25
Heptachlor Epoxide, 25
History, occupational and
obstetrical, 7
Home, exposures in, 8
Hot environment,
See Heat
Hydantoins, 27
Hyperglycemia, 21
Hypertension and Hypertensive states
of pregnancy, 19, 21, 29
Hyperventilation, 17, 31
Hypoglycemia, 21
Hypoxia, 31

I

Incontinence,
See Urination
Indomethacin, 27
Infection, 19, 23, 32
Infertility, 20, 26
Infrared, 23
Insomnia, 18
Interaction of substances, 3

J

Job exposures
- as disability, 4
- male, 6
- history, 7, 10
- diary, 7
- additive effects on, 8
Job, knack of, 8
Job modification
- assumption about, 2
- and employer, 2, 11
- records, 10
- desirable, 12
- essential, 12
- duration of, 13
- fatigue, 22
Job titles, 7

K

Kyphosis, Thoracic, 17, 33

L

Lactation
- puerperium, 18
- mercury, 25
- organic compounds, 25
Laser, 23
Lead, 7, 24, 25, 31
Legal implications, 4
Lifting, 34, 35
Lithium, 25, 27
Lochia, 18
Lordosis, 17, 33

M

Males, exposure of, 6, 10
Malnutrition,
See Nutrition
Marfan's Syndrome, 29
Medications,
See Pharmaceuticals
Meprobamate, 27
Mercury, 6, 25
Methemoglobinemia, 30
Methotrexate, 27
Methyl Chloride, 30
Methylene Chloride, 31
Microcephaly, 26
Microwave, 23
Mitomycin, 27
Mitral Stenosis, 29
Modifications of job,
See Job Modifications
Monitoring
- biological, 7
- environmental, 7
- radiation, 23
Multiple pregnancy, 22
Muscles, 18, 33
Musculoskeletal system, 33
Mutagenesis, 26
Myalgia, 18

N

National Institute for Occupational Safety & Health, iii, viii, 7, 10
Nausea, 17, 21
Nerve root disorders, 36
Neuralgia, 36
Neurologic complications, 36
Neurologic system, 36
Neurotoxicity, 26
Nitrobenzene, 31
Nitrofurantoin, 27
Noise, 37
Nursing,
See Lactation
Nutrition, 19, 22, 34

O

Obesity, 19
Occupational Safety & Health Act (OSH), 3
Occupational Safety & Health Administration (OSHA), 7, 10
Operating room,
See Anesthetic gases
Organogenesis, 24, 26
Orthopedic Disease, 34, 36
Oxychlordane, 25
Oxygenation, 20
Oxygen - carrying capacity of blood, 30, 31
Oxygen - debt, 18, 31
See also Respiration

P

Perchlorethylene, 25
Pharmaceuticals, 8, 18, 19, 23, 26-28
Phenobarbitol, 26

Phenytoin sodium, 26
Physical stress,
See Stress, physical
Physician, attending
- assumption about, 1, 2
Physician, occupational
- assumption about, 2, 3
- role of, 2, 11
Pinocytosis, 20
Placenta, 20, 23
Pneumoconiosis, 32
Pneumonia, 32
Policy, public, physician's role, 2, 4
Pollen, 32, 33
Polybrominated biphenyls, 25
Polychlorinated biphenyls, 25
Postpartum period, 18
Posture, 34
Pregnancy
- as disability, 3
- attrition, cause of, 6
- and work, fundamental principle, 12
- and work, systems review, 17
- physiologic changes in, 20, 28, 31, 33, 36
- by trimester, 17
Premature labor, 21
Prematurity, 20
Progesterone, 17, 31
Progestins, 26
Promethazine, 27
Protozoan infection, 24
Puerperium, 18
See also Postpartum
Pulling, 34, 35
Pulmonary complications, 25, 32
Pulmonary system, 31
Pulse, 18
Pushing, 34, 35
Pyelonephritis, 30

Q

Questions about job exposures, 9
Quinine, 27

R

Radiant energy, 23
Radiation
- ionizing, 6, 23
Recommendations to patient
- assumption about, 2
Reconditioning, physical, 8
Records, medical, 7
Recovery, following delivery, 22, 23
Relations, interprofessional, 11
Renal system, 17
- renal plasma flow, 17
Reproductive system, 20
Research
- assumptions about, 1
Respiration, 18, 31
See also Ventilation, Pulmonary Complications, Hyperventilation
Rheumatic Heart Disease, 29
Rhinitis, 32
Rh Isoimmunization, 21
Routine, 34

S

Sacroiliac joints, 17, 34
Sawdust, 33
Scoliosis, 34
Seizures, 36
Shift, 34
Shoes, 34
Sitting, 35
Slipping, 34, 35
See also Falls
Smoke, 33
Smoking, 8, 19, 28
Sperm disorders, 26
Standards, 3
Standing, 18, 35
Stibine, 31
Stillbirth, 6, 24
Strength, 34, 35
Streptomycin, 27
Stress, emotional 8, 36
Stress, physical, 7, 20, 22, 29 34, 35
See also Effort, physical
Stroke volume, 28
Sulfonamides, 27
Symphyseal joints, 17, 34
Syncope, 17, 30
Syphilis, 25

T

Temperature,
See Heat & Humidity

Teratogenesis, 6, 26
Tetra-chloro-dibenzo Dioxin, 25
Tetracycline, 27
Thiazides, 27
Thioureas, 27
Trichloroethylene, 25
Trimesters, Physiologic changes of
    pregnancy, 17
Trimethadione, 26
Trinitrotoluene, 31
Tuberculosis, 32

U

Ultrasound, 37
Ultraviolet, 23
Ureters, 18
Urinary tract infection, 30
Urination, frequency of, 17, 18
Uterus,
- changes in pregnancy, 17, 18
- postpartum, 18
- blood flow, 20
- structural anomaly, 20, 21
- and cardiovascular system, 28
- musculoskeletal system, 34

V

Varicose veins, 18
Vascular narrowing, 20
Vasoconstriction, 20
Vasoconstrictors, 32
Venous return, 18
Ventilation rate, in pregnancy, 18
Vibration, 37
Vinyl Chloride, 24, 25, 26
Viruses, 24
Vomiting, 18, 21

W

Warfarin, 27
Waste Anesthetic gases,
    See Anesthetics
Weather, 22
Weight bearing, 34, 35, 36
Weight gain in pregnancy, 17, 18,
    19, 33
Weight loss, postpartum, 18

* U.S. GOVERNMENT PRINTING OFFICE: 1978— 757-141/6763